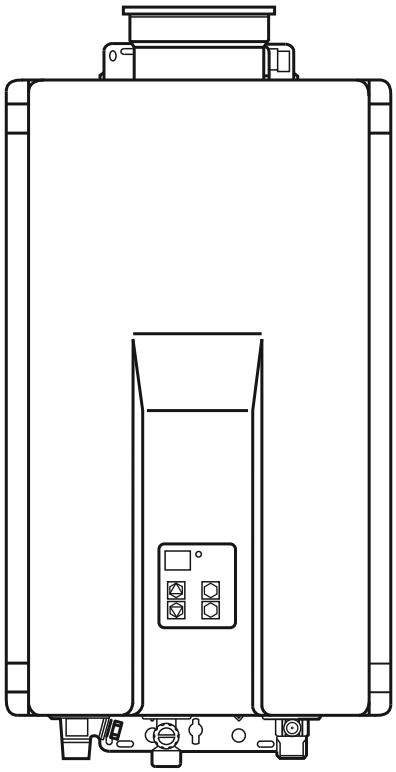
On-Demand Water Heater System Design Manual

Design information for single and multiple unit installations for residential, commercial, recirculation and storage tank systems.



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Approvals

ATI-305-N	GTS-305-NI	GT-305-NI
ATI-305-P	GTS-305-PI	GT-305-PI
ATO-305-N	GTS-305-NE	GT-305-NE
ATO-305-P	GTS-305-PE	GT-305-PE
ATI-505-N	GTS-505-NI	GT-505-NI
ATI-505-P	GTS-505-PI	GT-505-PI
ATO-505-N	GTS-505-NE	GT-505-NE
ATO-505-P	GTS-505-PE	GT-505-PE
ATI-705-N	GTS-705-NI	GT-705-NI
ATI-705-P	GTS-705-PI	GT-705-PI
ATO-705-N	GTS-705-NE	GT-705-NE
ATO-705-P	GTS-705-PE	GT-705-PE
*ATI-705A-N	*GTS-705-NIA	*AGT-705-NI
*ATI-705A-P	*GTS-705-PIA	*AGT-705-PI
*ATO-705A-N	*GTS-705-NEA	*AGT-705-NE
*ATO-705A-P	*GTS-705-PEA	*AGT-705-PE

The models listed in this manual have received the following certifications except where noted:

Certified to applicable U.S. standards for appliances using gas or other petroleum fuel.

Air-Conditioning, Heating and Refrigeration Institute

Certified to applicable Canadian standards for appliances using gas or other petroleum fuel.

Met the California Energy Commission (CEC) standards

Approved by the Commonwealth of Massachusetts (G1-0208-249)

Certified by the Uniform Plumbing Code (UPC)

Received New York City's Material and Equipment Acceptance (MEA)
(MEA 327-02-E Vol. 09)
(MEA 327-02-E Vol. 10)
(MEA 327-02-E Vol. 11)

Certified by National Sanitation Foundation (NSF), www.nsf.org

(indoor models must use the NSF approved top guard)

*Water heaters are built in accordance with the requirements of the ASME Boiler and Pressure Vessel Code and received the Certificate of Authorization from the National Board. The heat exchanger has the NB and the HLW stamps.

The California Safe Drinking Water and Toxic Enforcement Act requires the Governor of California to publish a list of substances known to the State of California to cause cancer, birth defects, or other repoductive harm, and requires businesses to warn of potential exposure to such substances.

WARNING: This product contains a chemical known to the State of California to cause cancer, birth defects, or other reproductive harm.

This appliance can cause low-level exposure to some of the substances included in the Act.

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Installation

Consumer Information

The on-demand water heaters must be installed according to all local and state codes or, in the absence of local and state codes, the “National Fuel Gas Code”, ANSI Z223.1 (NFPA 54) - current edition.

CSA American, Inc.
8501 East Pleasat Valley Road
Cleveland, OH 44131

National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02269

Check your phone listings for the local authorities having jurisdiction over your installation.

Consumer Responsibilities

This manual has been prepared to acquaint you (trained service technician) with the installation, operation, and maintenance of the on-demand water heater and provide important safety information in these areas.

Read all of the instructions thoroughly before attempting the installation or operation of the water heater.

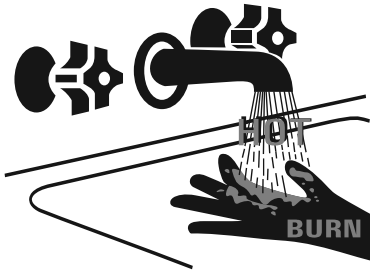
Service to the on-demand system should only be performed by a trained service technician.

Massachusetts code requires this water heater to be installed in accordance with Massachusetts Plumbing and Fuel Gas Code 248 CMR Section 2.00 and 5.00.

Water Temperature Regulation

For systems with storage tanks, the water temperature in certain situation may vary up to 30°F (16.7°C) higher or lower at the point of use such as, bathtubs,showers, sink, etc. HOTTER WATER CAN SCALD: Water heaters, are intended to produce hot water. Water heated to a temperature which will satisfy space heating, clothes washing, dish washing, and other sanitizing needs can scald and permanently injure you upon contact. Some people are more likely to be permanently injured by hot water than others. These include the elderly, children, the infirm, or physically/ mentally handicapped. If anyone using hot water in the home fits into one of these groups or if there is a local code or state law requiring a certain temperature water at the hot water tap, then you must take special precautions.

⚠WARNING



Water temperature over 125°F can cause severe burns instantly or death from scalds.

Children, disabled and elderly are at highest risk of being scalded.

Feel water before bathing or showering.

Temperature limiting valves are available.

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Installation

In addition to using the lowest possible temperature setting that satisfies your hot water needs, a means such as a mixing valve, should be used at hot water taps used by these people or at the water heater.

Mixing valves are available at plumbing supply or hardware stores. Follow manufacturer's instructions for installation of the valves. Before changing the factory setting on the thermostat see table below. Using the lowest hot water temperature that meets your needs will also provide the most energy efficient operation of the water heater.

Never allow small children to use a hot water tap, or to draw their own bath water. Never leave a child or handicapped person unattended in a bathtub or shower.

NOTE: A water temperature range of 120°F - 140°F (49°C-60°C) is recommended by most dishwasher manufacturers.

Temperature Settings	Time to Produce 2nd & 3rd Degree Burns on Adult Skin
160°F (71°C)	About 1/2 second
150°F (66°C)	About 1-1/2 seconds
140°F (60°C)	Less than 5 seconds
130°F (54°C)	About 30 seconds
120°F (49°C)	More than 5 minutes
80°F (27°C)	- - - - - - - - - - - - - - - -

Table "A"

The thermostat of the water heater has been factory set at 120° F, to reduce the risk of scald injury. It is adjustable and can be reset to the desired temperature setting. Some states have a requirement for a lower setting. If you need hotter water, follow directions for temperature adjustment, but beware of the warnings in this section.

Site Location

- Select a location near the center of the water piping system.
- Consider the exhaust vent system piping and combustion air supply requirements when selecting the water heater location. The venting system must be able to run from the water heater to the termination with a minimal length and number of elbows.
- Locate the water heater near the existing gas piping. If installing a new gas line, locate the water heater to minimize the pipe length and elbows.

NOTE: This water heater must be installed according to all local and state codes or, in the absence of local and state codes, the "National Fuel Gas Code", ANSI Z223.1(NFPA 54)-current edition.

- The water heater should be located in an area not subject to freezing temperatures. Water heaters located in unconditioned spaces (i.e., attics, basements, etc.) may require insulation of the water piping and drain piping to protect against freezing. The drain and controls must be easily accessible for operation and service. Maintain proper clearances as specified on the data plate.

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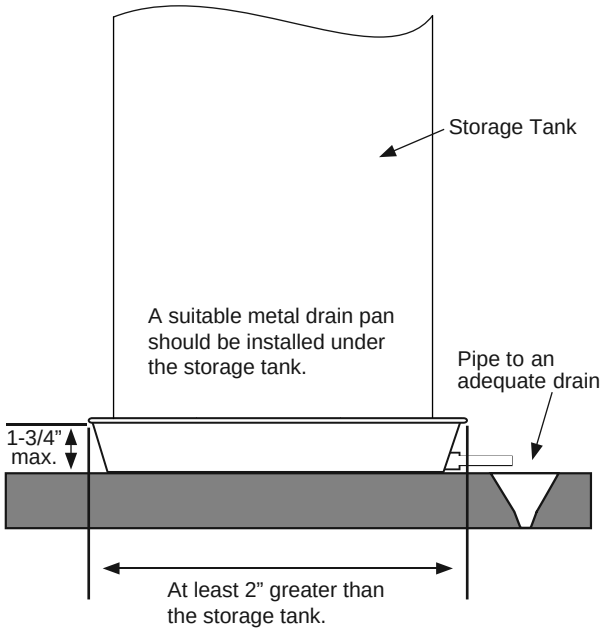
For Storage Tank System Installation

CAUTION - PROPERTY DAMAGE HAZARD

The storage tank should be located in an area where leakage of the tank or connections will not result in damage to the area adjacent to the storage tank or to lower floors of the structure. Due to the normal corrosive action of the water, the tank will eventually leak after an extended period of time. Also any external plumbing leak, including those from improper installation, may cause early failure of the tank due to corrosion if not repaired. If the owner/ operator is uncomfortable with making the repair a qualified technician should be contacted. A suitable metal drain pan should be installed under the storage tank as shown below, to help protect the property from damage which may occur from condensate formation or leaks in the piping connections or tank. The pan must limit the water level to a maximum depth of 1-3/4" and be two inches wider than the tank and piped to an adequate drain. NOTE: The pan must not restrict combustion air flow. Locate the storage tank near a suitable indoor drain. Outside drains are subject to freezing temperatures which can obstruct the drain line. The piping should be at least 3/4" ID and pitched for proper drainage.

Figure "1"


Storage Tank
A suitable metal drain pan should be installed under the storage tank.
Pipe to an adequate drain
1-3/4" max.
At least 2" greater than the storage tank.

Closed System/Thermal Expansion

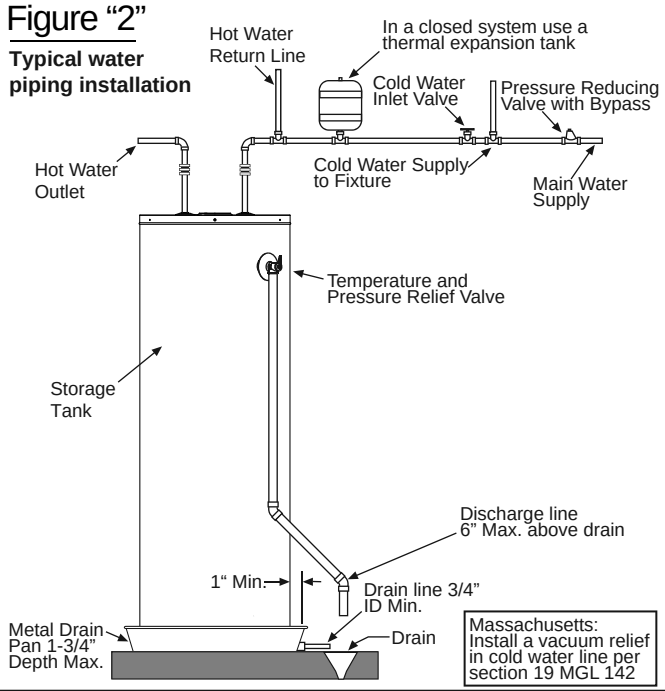
CAUTION - PROPERTY DAMAGE HAZARD

As water is heated, it expands (thermal expansion). In a closed system, the volume of water will grow. As the volume of water grows, there will be a corresponding increase in water pressure due to thermal expansion. Thermal expansion can cause premature tank failure (leakage). This type of failure is not covered under the limited warranty. Thermal expansion can also cause intermittent temperature-pressure relief valve operation: water discharged from the valve due to excessive pressure build up. The temperature / pressure relief valve is not intended for the constant relief of thermal expansion. This condition is not covered under the limited warranty.

A properly-sized thermal expansion tank should be installed on all closed systems to control the harmful effects of thermal expansion. Contact a local plumbing service agency to have a thermal expansion tank installed.

Figure "2"

Typical water piping installation


Hot Water Return Line
In a closed system use a thermal expansion tank
Cold Water Inlet Valve
Pressure Reducing Valve with Bypass
Hot Water Outlet
Cold Water Supply to Fixture
Main Water Supply
Temperature and Pressure Relief Valve
Storage Tank
Discharge line 6" Max. above drain
1" Min.
Drain line 3/4" ID Min.
Metal Drain Pan 1-3/4" Depth Max.
Drain
Massachusetts: Install a vacuum relief in cold water line per section 19 MGL 142

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For Storage Tank System Installation

Temperature and Pressure Relief Valve

For protection against excessive pressures and temperatures, a temperature and pressure relief valve must be installed in the opening on the on-demand storage tank. This valve must be design certified by a nationally recognized testing laboratory that maintains periodic inspection of the production of listed equipment or materials as meeting the requirements for Releif Valves for Hot Water Supply Systems, ANSI Z21.22. The function of the temperature and pressure relief valve is to discharge water in large quantities in the event of excessive temperature or pressure developing in the water heater. The valve's relief pressure must not exceed the working pressure of the water heater as stated on the data plate.

IMPORTANT: Only a new temperature and pressure relief valve should be used with your water heater. Do not use an old or existing valve as it may be damaged or not adequate for the working pressure of the new water heater. Do not place any valve between the relief valve and the tank.

⚠WARNING

Explosion Hazard

If the temperature and pressure relief valve is dripping or leaking, have a qualified service technician replace it.

Examples of a qualified service technician include: Licensed plumbers, authorized gas company personnel, and authorized service personnel.

Do not plug valve.

Do not remove valve.

Failure to follow these instructions can result in death, or explosion.

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Water Quality and Scale

A complete water analysis and an understanding of system requirements are needed to protect the on-demand water heaters and water heating systems from scale. Water analysis shows whether water is hard or soft. Hard water, unless treated, will cause scaling or liming of the heat exchanger. The rate of scaling increases with temperature and usage because calcium carbonate and other scaling compounds lose solubility (fall out of solution) at higher temperatures. For example, for every 20°F over 140°F, the rate of scale increases by a factor of 2 (See figure below). Reference target water quality levels found in the operation / installation manual and consider water treatment if these levels are exceeded. *

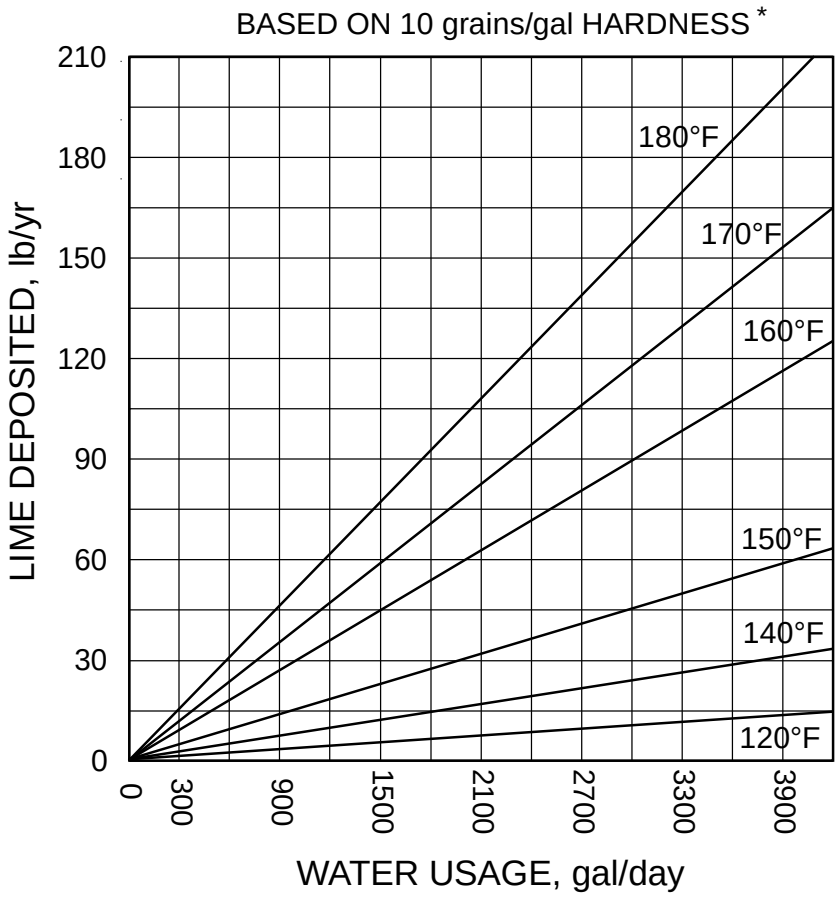

Figure "3"

*Source 2003 ASHRAE Handbook HVAC Applications

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Pump Sizing for Circulation

1. Use the chart below or one appropriate for your conditions to determine the heat loss in the length of the hot water supply and return piping. For example, 100 ft of 1-1/2 in bare copper tubing results in a heat loss of 5300 Btu/h.

Approximate Heat Loss from Piping at 140 ºF Inlet, 70 ºF Ambient *

Nominal Size, in.	Bare Copper Tubing, Btu/h-ft	1/2 in. Glass Fiber Insulated Copper Tubing, Btu/h-ft
3/4	30	17.7
1	38	20.3
1-1/4	45	23.4
1-1/2	53	25.4
2	66	29.6
2-1/2	80	33.8
3	94	39.5
4	120	48.4

* Source: 2003 ASHRAE Handbook HVAC Applications

Table “B”

2. Determine the acceptable temperature drop at the last fixture in the loop. For example, if the supply temperature from the water heater is 120 ºF (49 ºC) and an acceptable temperature at the last fixture is 100 ºF (38 ºC) then the acceptable temperature drop is 20 ºF (7 ºC).
3. Calculate the required pump flow rate using the following formula:

$$\text{FLOW RATE (gpm)} = \frac{\text{HEAT LOSS (BTU / h)}}{500 \times \text{ACCEPTABLE TEMPERATURE DROP (ºF)}}$$

4. Based on the above calculations select a pump for the type of circulation system you will be utilizing:

   A). Preferred Method (reference drawing H-1-RP) - Reference pump manufacturers flow vs. pressure specifications to select a pump that can provide the flow rate calculated above while overcoming the pressure loss through:

   - Tank water heater (reference manufacturer’s information)
   - All building supply and return plumbing in the circulation loop (reference local plumbling codes, standards, or practices)

   B). Optional Method (H-1-RO) - Reference pump manuf acturers flow vs. pressure specifications to select a pump that can provide 3 gpm of flow or the flow rate calculated above, whichever is greater, while overcoming the pressure loss through:

   - On demand water heater (reference flow vs. pressure curve of the model being used)
   - Optional storage tank (reference manufacturer’s information)
   - All building supply and return plumbing in the circulation loop (reference local plumbling codes, standards, or practices)

NOTE: Only use pumps of brass or stainless steel construction. Do not use pumps of iron construction as they will oxidize and clog the inlet filter on the appliance.

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Tank Water Heaters in a Circulation Loop

The following applies when using a tank water heater (gas or electric) to provide heat for a circulation loop. Drawing H-1-RP is an example.

The heat ***output*** of the tank must be equal to or greater than the calculated circulation loop heat loss.

(Reference page 5, Step 1 on calculating heat loss).

Electric Tank Water Heater

Since the input and output are the same for an electric tank water heater, this can be expressed as:

$$\text{Electric Tank Input (Kw)} \geq \frac{\text{Circulation loop heat loss (Btu/h)}}{3413}$$

(1 Kilowatt = 3,413 BTU)

Gas Tank Water Heater

When using a gas style water heater, the efficiency of the tank must be taken into account.

Available Btu output = (Btu input of tank) x (efficiency) $\geq$ Circulation loop heat loss (Btu/h)

Example:

30,000 Btu input gas tank
0.62 Efficiency

30,000 x .62 = 18,600 available Btu output

Additional Guidelines

On-demand water heaters not recovering a storage tank: In applications involving a commercial dishwasher, a hot water circulation loop feeding the dishwasher is required.

On-demand water heater recovering a storage tank: In applications involving a commercial dishwasher, a hot water circulation loop feeding the dishwasher may be required depending on the distance between the dishwasher and the storage tank. Refer to local codes when determining the need for circulation loops to dishwashers.

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Pump Sizing for Storage Tank Application

The following applies when using on-demand water heaters to recover a storage tank. Drawing H-1-TC is an example.

On-Demand water heaters have a pressure loss which must be considered in the system design. Reference the pressure loss curve for the heater model being used to determine the pump size for the desired recovery rate.

For recommended pump sizes use the table below. Additional pressure losses in plumbing between the Heater(s) and the storage tank must also be taken into consideration.

The specified pump size is to provide maximum recovery of the storage tank. A smaller pump size may be used, but could result in longer recovery time of the tank. Please contact the Tech Services department with any questions on pump sizing.

NOTE: Only use pumps of brass or stainless steel construction. Do not use pumps of iron construction as they will oxidize and clog the inlet filter on the appliance.

Pump Flow Requirements		
Number of On-Demand Water Heaters	**705/505**	**305**
1	6 gpm @ 30' head	5 gpm @ 25' head
2	12 gpm @ 30' head	10 gpm @ 25' head
3	18 gpm @ 30' head	15 gpm @ 25' head
4	24 gpm @ 30' head	20 gpm @ 25' head
5	30 gpm @ 30' head	25 gpm @ 25' head
6	36 gpm @ 30' head	30 gpm @ 25' head
7	42 gpm @ 30' head	35 gpm @ 25' head
8	48 gpm @ 30' head	40 gpm @ 25' head
9	54 gpm @ 30' head	45 gpm @ 25' head
10	60 gpm @ 30' head	50 gpm @ 25' head
11	66 gpm @ 30' head	55 gpm @ 25' head
12	72 gpm @ 30' head	60 gpm @ 25' head
13	78 gpm @ 30' head	65 gpm @ 25' head
14	84 gpm @ 30' head	70 gpm @ 25' head
15	90 gpm @ 30' head	75 gpm @ 25' head

Table “C”

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100/101 Series
Pressure Loss Curves

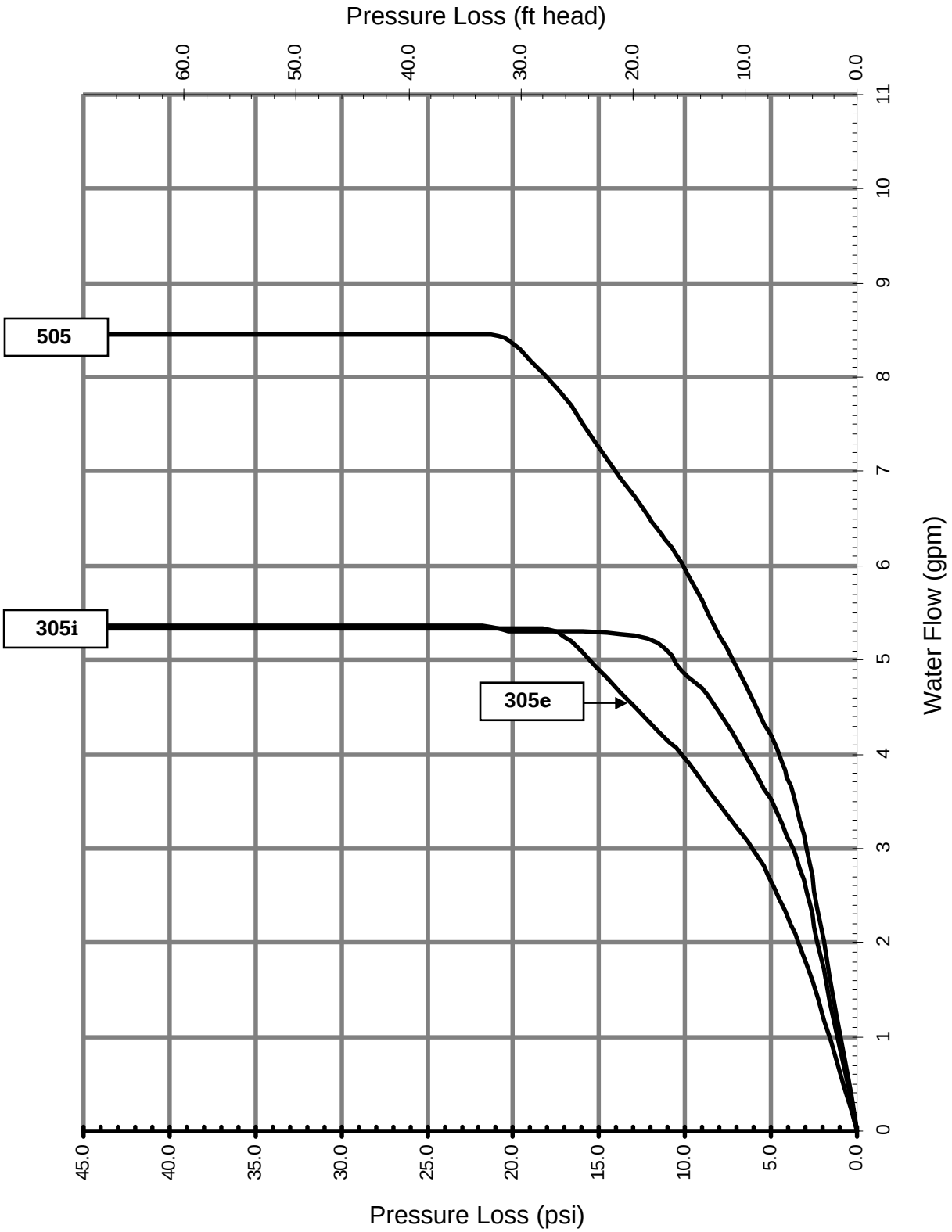

Figure "4"

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200/201 Series
Pressure Loss Curves

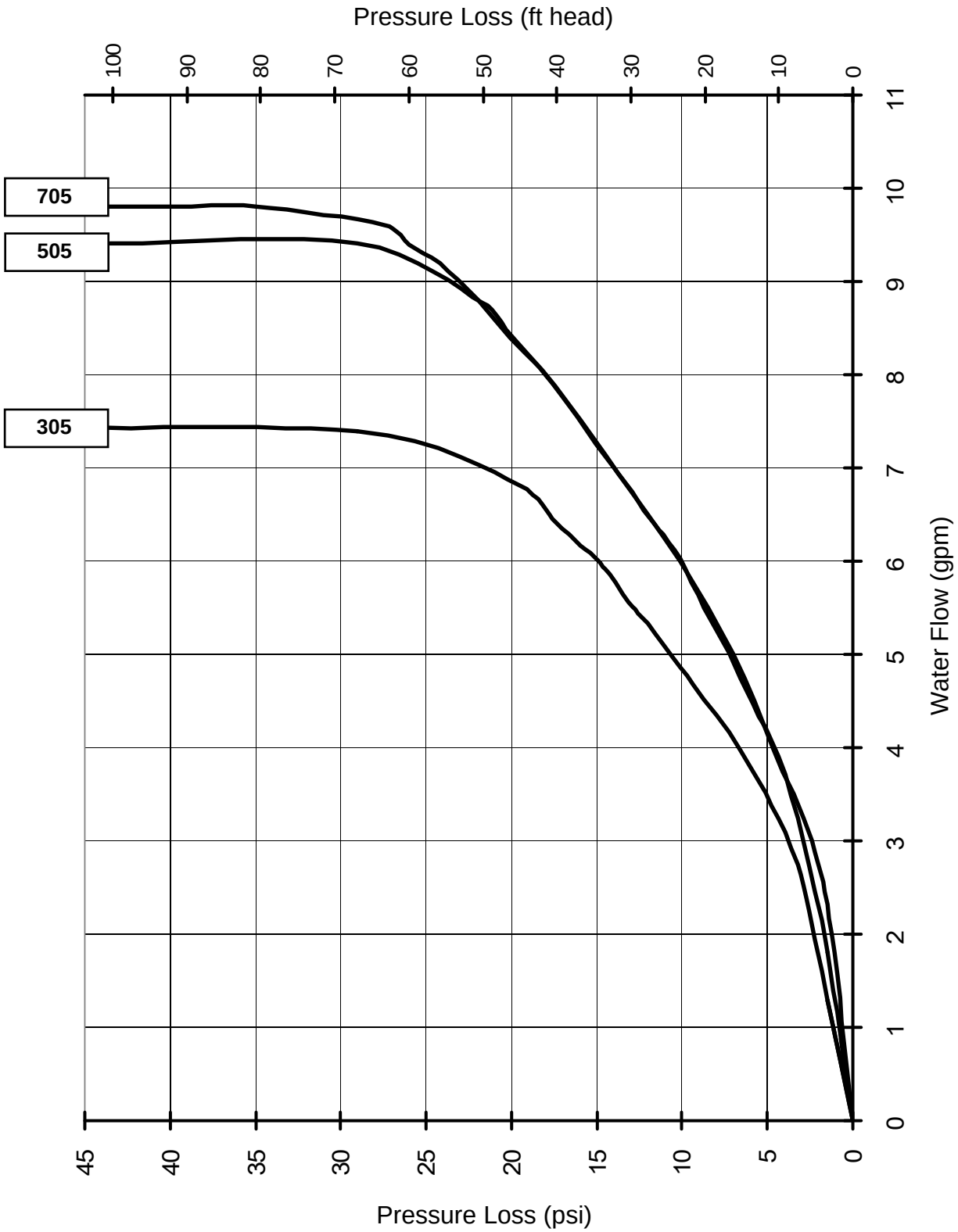

Figure "5"

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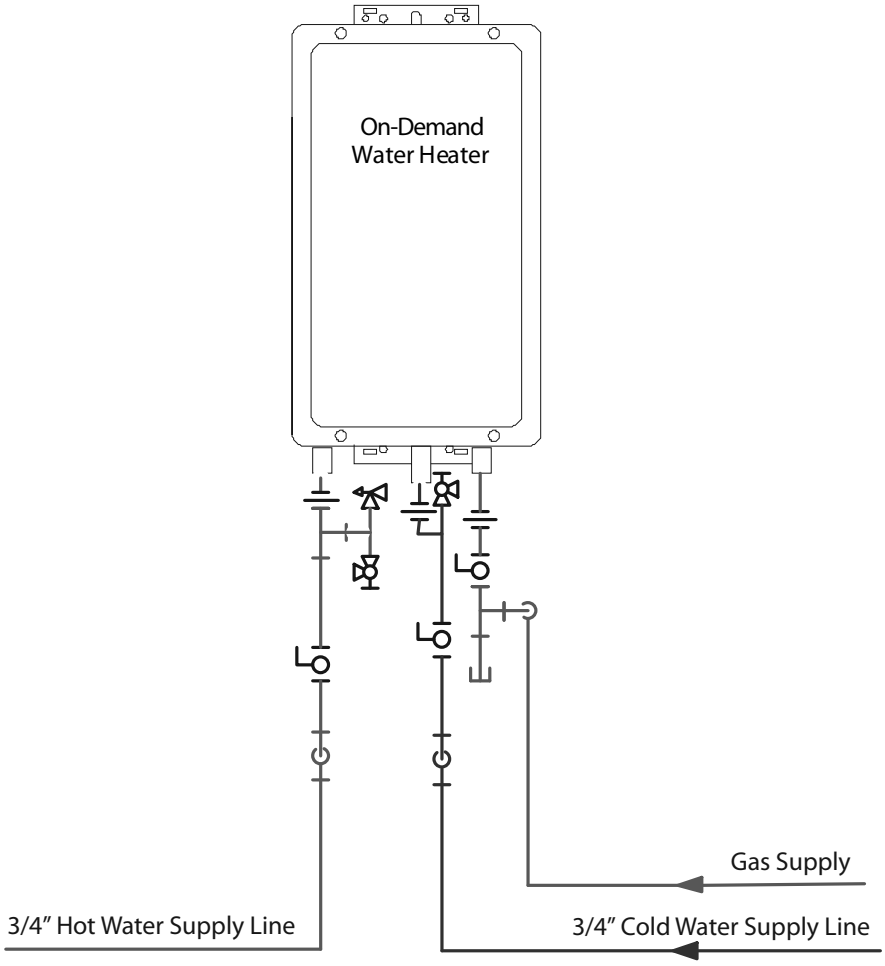
On-Demand Equipment List	QTY
On-Demand Water Heaters	1



Domestic Hot Water - Standard Installation
1 On-Demand Water Heater
Preferred Piping Installation

Key

- 3/4" Ball Valve
- 3/4" Union
- Check Valve
- Pressure Relief Valve
- Pressure Regulator
- Circulating Pump
- Boiler Drain Valve
- Solenoid Valve
- Mixing Valve

NOTE: This drawing is not intended to describe a complete system and is not a replacement for a professional engineering drawing. It is intended only as a guide and does not imply compliance with local building code requirements. Confer with local building officials before installation. The Contractor or engineer is to determine the necessary components and configuration of the particular system to be installed. It is the responsibility of the engineer or contractor to ensure that the installation is in accordance with all local building codes.

Drawing Date: September 07, 2008

Drawing Number: H-1

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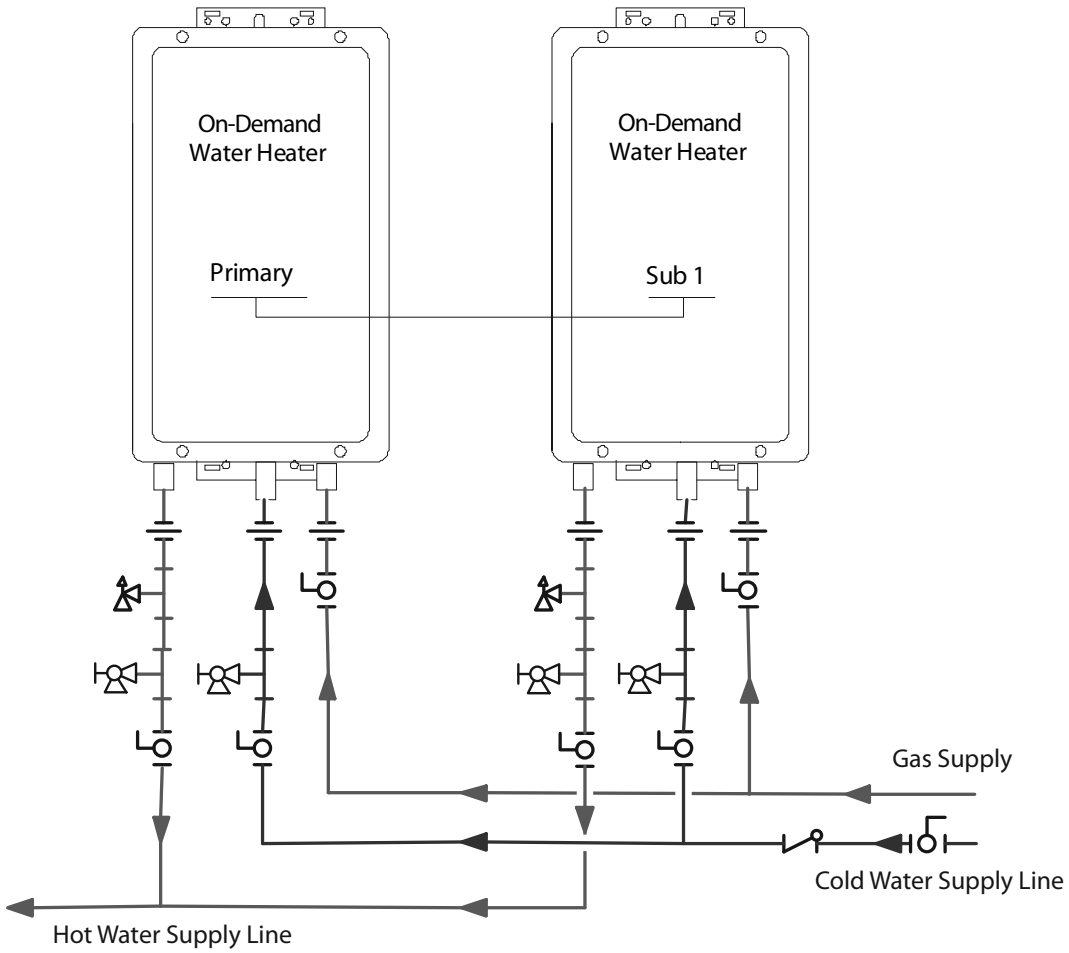
On-Demand Equipment List	QTY
On-Demand Water Heaters	2
Electronic Connection *	

* Refer to On-Demand Accessories and Model Applicability for electronic connection details.



Domestic Hot Water - Standard Installation
2 On-Demand Water Heaters
Preferred Piping Installation

Key

- 3/4" Ball Valve
- 3/4" Union
- Check Valve
- Pressure Relief Valve
- Pressure Regulator
- Circulating Pump
- Boiler Drain Valve
- Solenoid Valve
- Mixing Valve

NOTE: This drawing is not intended to describe a complete system and is not a replacement for a professional engineering drawing. It is intended only as a guide and does not imply compliance with local building code requirements. Confer with local building officials before installation. The Contractor or engineer is to determine the necessary components and configuration of the particular system to be installed. It is the responsibility of the engineer or contractor to ensure that the installation is in accordance with all local building codes..

Drawing Date: September 07, 2008

Drawing Number: H-2

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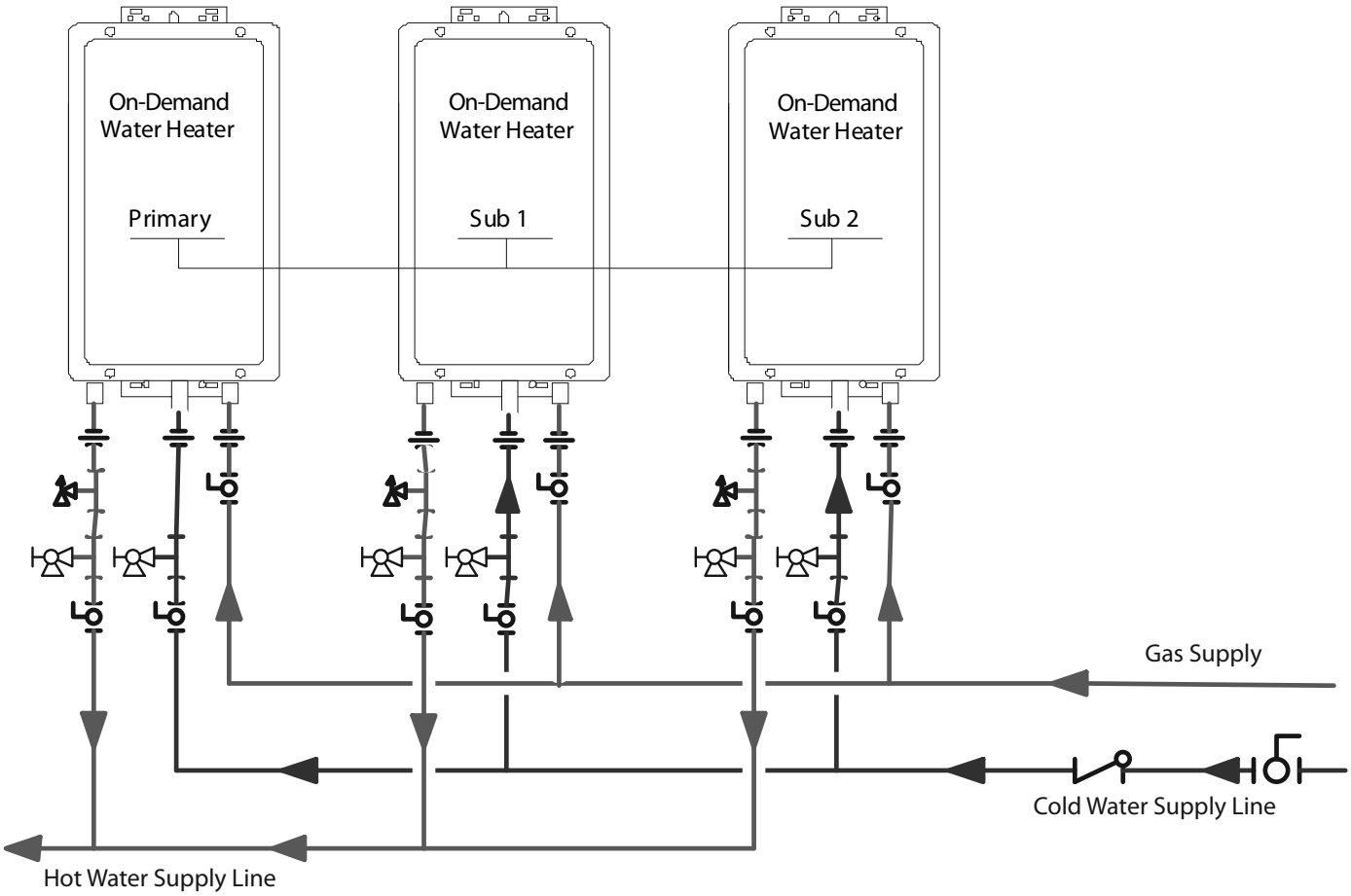
On-Demand Equipment List	QTY
On-Demand Water Heaters	3
Electronic Connection *	

* Refer to On-Demand Accessories and Model Applicability for electronic connection details.



Domestic Hot Water - Standard Installation
3 On-Demand Water Heaters
Preferred Piping Installation

Key

- 3/4" Ball Valve
- 3/4" Union
- Check Valve
- Pressure Relief Valve
- Pressure Regulator
- Circulating Pump
- Boiler Drain Valve
- Solenoid Valve
- Mixing Valve

NOTE: This drawing is not intended to describe a complete system and is not a replacement for a professional engineering drawing. It is intended only as a guide and does not imply compliance with local building code requirements. Confer with local building officials before installation. The Contractor or engineer is to determine the necessary components and configuration of the particular system to be installed. It is the responsibility of the engineer or contractor to ensure that the installation is in accordance with all local building codes.

Drawing Date: September 07, 2008

Drawing Number: H-3

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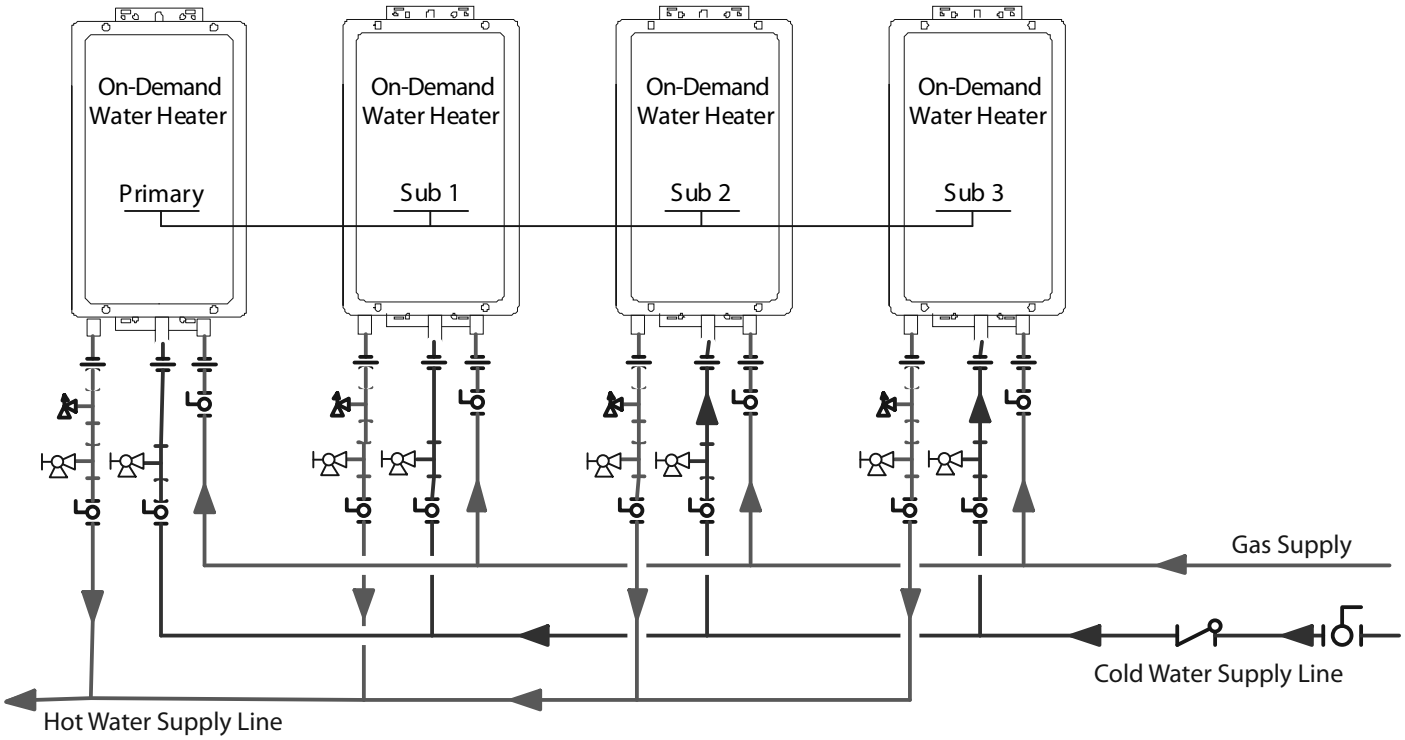
On-Demand Equipment List	QTY
On-Demand Water Heaters	4
Electronic Connection *	

* Refer to On-Demand Accessories and Model Applicability for electronic connection details.



Domestic Hot Water - Standard Installation
4 On-Demand Water Heaters
Preferred Piping Installation

Key

3/4" Ball Valve | Check Valve | Pressure Regulator | Boiler Drain Valve
3/4" Union | Pressure Relief Valve | Circulating Pump | Solenoid Valve | Mixing Valve

NOTE: This drawing is not intended to describe a complete system and is not a replacement for a professional engineering drawing. It is intended only as a guide and does not imply compliance with local building code requirements. Confer with local building officials before installation. The Contractor or engineer is to determine the necessary components and configuration of the particular system to be installed. It is the responsibility of the engineer or contractor to ensure that the installation is in accordance with all local building codes.

Drawing Date: September 07, 2008

Drawing Number: H-4

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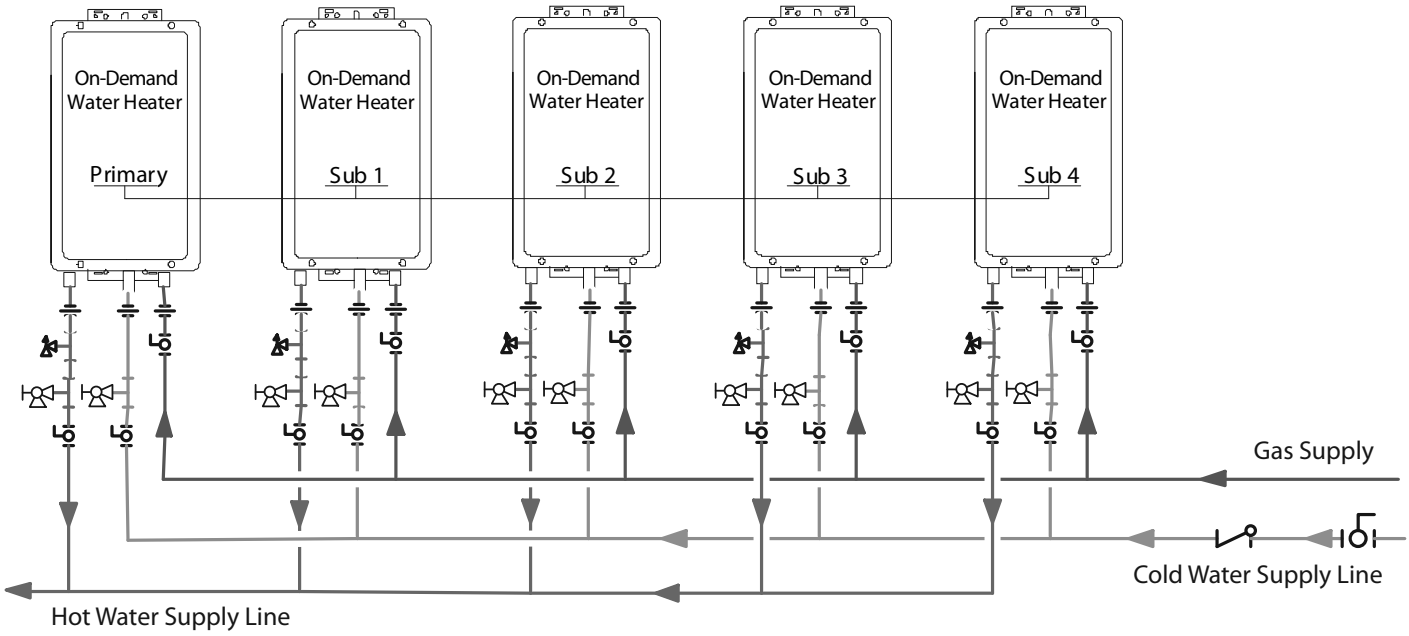
On-Demand Equipment List	QTY
On-Demand Water Heaters	5
Electronic Connection *	

* Refer to On-Demand Accessories and Model Applicability for electronic connection details.



Domestic Hot Water - Standard Installation
5 On-Demand Water Heaters
Preferred Piping Installation

Key

3/4" Ball Valve
3/4" Union
Check Valve
Pressure Relief Valve
Pressure Regulator
Circulating Pump
Boiler Drain Valve
Solenoid Valve
Mixing Valve

NOTE: This drawing is not intended to describe a complete system and is not a replacement for a professional engineering drawing. It is intended only as a guide and does not imply compliance with local building code requirements. Confer with local building officials before installation. The Contractor or engineer is to determine the necessary components and configuration of the particular system to be installed. It is the responsibility of the engineer or contractor to ensure that the installation is in accordance with all local building codes.

Drawing Date: September 07, 2008

Drawing Number: H-5

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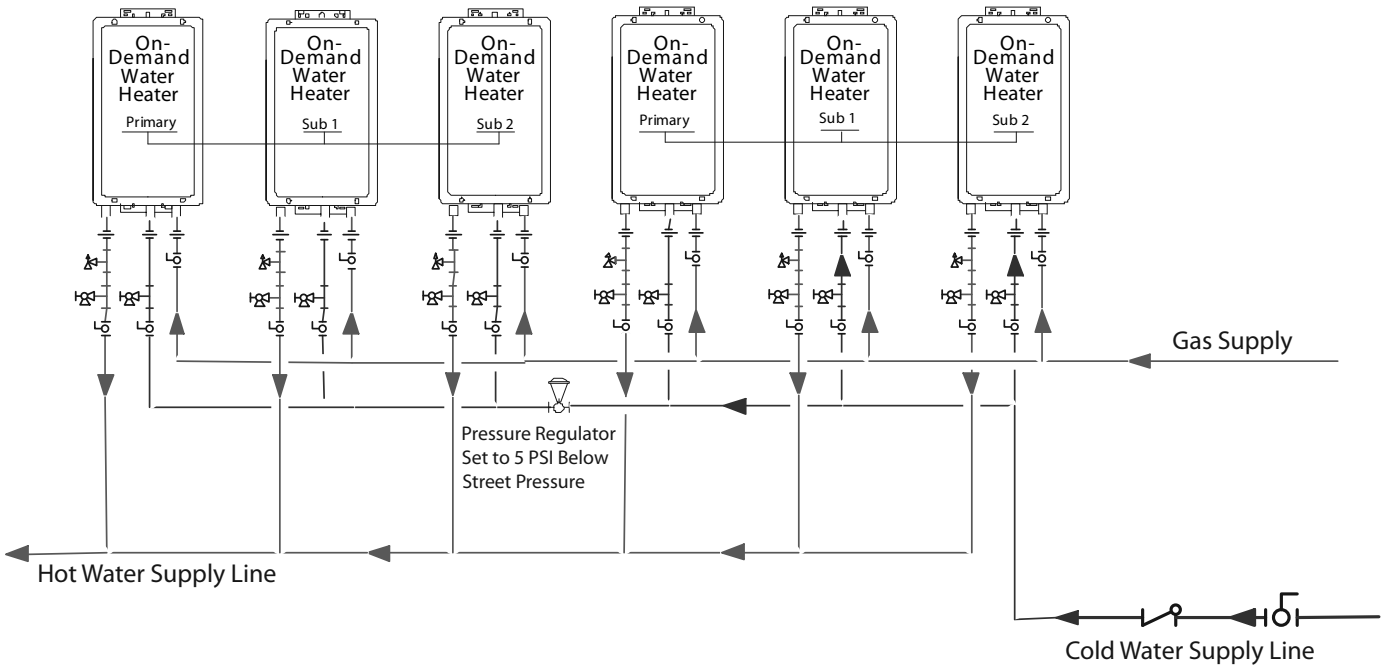
On-Demand Equipment List	QTY
On-Demand Water Heaters	6
Electronic Connection *	

* Refer to On-Demand Accessories and Model Applicability for electronic connection details.



Domestic Hot Water - Standard Installation
6 On-Demand Water Heaters
Preferred Piping Installation

Key

- 3/4" Ball Valve
- 3/4" Union
- Check Valve
- Pressure Relief Valve
- Pressure Regulator
- Circulating Pump
- Boiler Drain Valve
- Solenoid Valve
- Mixing Valve

NOTE: This drawing is not intended to describe a complete system and is not a replacement for a professional engineering drawing. It is intended only as a guide and does not imply compliance with local building code requirements. Confer with local building officials before installation. The Contractor or engineer is to determine the necessary components and configuration of the particular system to be installed. It is the responsibility of the engineer or contractor to ensure that the installation is in accordance with all local building codes.

Drawing Date: September 07, 2008

Drawing Number: H-6

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IMPORTANT!

With electrical power supplied to a on-demand water heater, it will not freeze in enviornments as cold as -30°F, when protected from direct wind exposure.

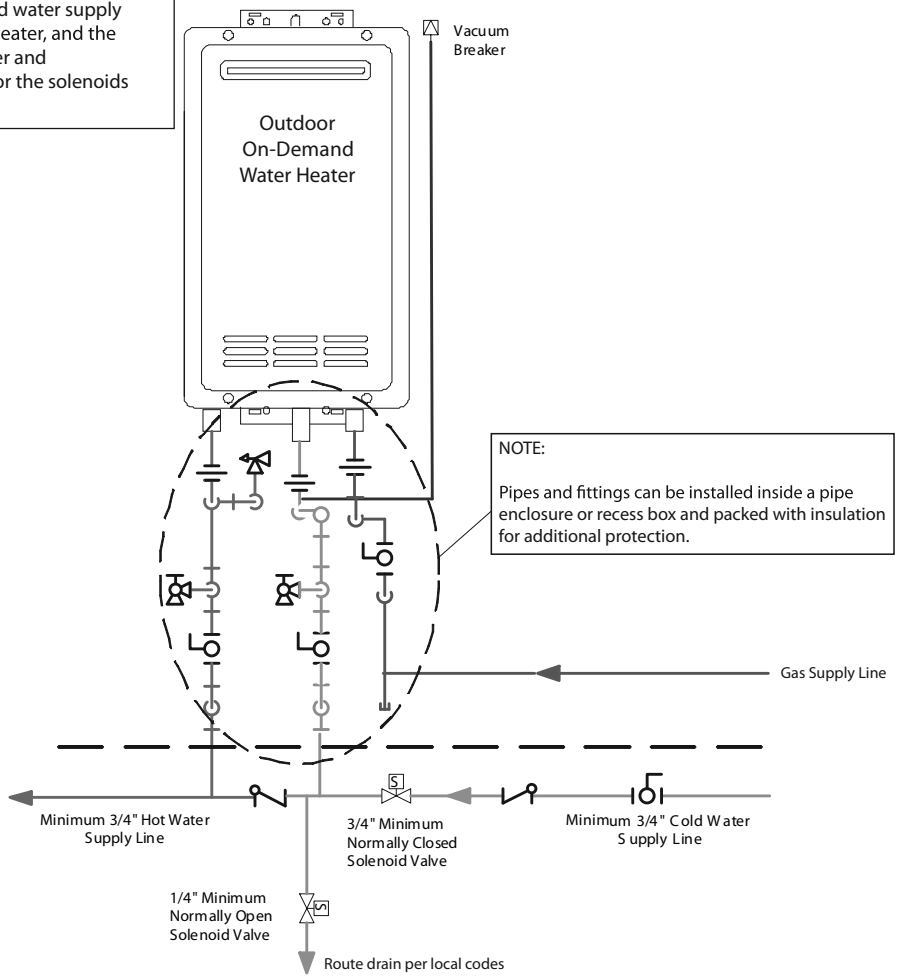
In the event of a power failure at temperatures below freezing, the water heater should be drained of all water to prevent freezing damage.

The unit may be drained manually or through the installation of the Optional solenoid valves as shown.

The electrical connections for the two solenoid valves should be tied to the 120 V power terminals provided on the PC Board of the water heater.

When the electrical power to the water heater fails, the cold water supply solenoid valve closes, stopping the flow of water into the heater, and the drain down solenoid valve opens, allowing the water heater and associated piping to drain. Ensure that you run the drain for the solenoids per local codes.

On-Demand Equipment List	QTY
Outdoor On-Demand Water Heater	1


Vacuum Breaker
Outdoor On-Demand Water Heater
NOTE:
Pipes and fittings can be installed inside a pipe enclosure or recess box and packed with insulation for additional protection.
Gas Supply Line
Minimum 3/4" Hot Water Supply Line
3/4" Minimum Normally Closed Solenoid Valve
Minimum 3/4" Cold Water Supply Line
1/4" Minimum Normally Open Solenoid Valve
Route drain per local codes

NOTE:

Freeze protect all water pipes and fittings located outside building structure. These are indicated by being above the dashed line.

All pipes and fittings shown below the dashed line should be located inside the building structure.

The vacuum breaker line should be located inside the building structure.

Domestic Hot Water - Optional Freeze Protection
1 Outdoor On-Demand Water Heater
Preferred Piping Installation

Key

3/4" Ball Valve
3/4" Union
Check Valve
Pressure Relief Valve
Pressure Regulator
Circulating Pump
Boiler Drain Valve
Solenoid Valve
Mixing Valve

NOTE: This drawing is not intended to describe a complete system and is not a replacement for a professional engineering drawing. It is intended only as a guide and does not imply compliance with local building code requirements. Confer with local building officials before installation. The Contractor or engineer is to determine the necessary components and configuration of the particular system to be installed. It is the responsibility of the engineer or contractor to ensure that the installation is in accordance with all local building codes.

Drawing Date: September 07, 2008

Drawing Number: H-1-E

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On-Demand
Equipment List QTY

On-Demand Outdoor Water Heaters 2

Electronic Connection *

* Refer to On-Demand Accessories and Model Applicability for electronic connection details.

IMPORTANT!

With electrical power supplied to a on-demand water heater, it will not freeze in enviornments as cold as -30°F, when protected from direct wind exposure.

In the event of a power failure at temperatures below freezing, the water heater should be drained of all water to prevent freezing damage.

The unit may be drained manually or through the installation of the Optional solenoid valves as shown.

The electrical connections for the two solenoid valves should be tied to the 120 V power terminals provided on the PC Board of the water heater.

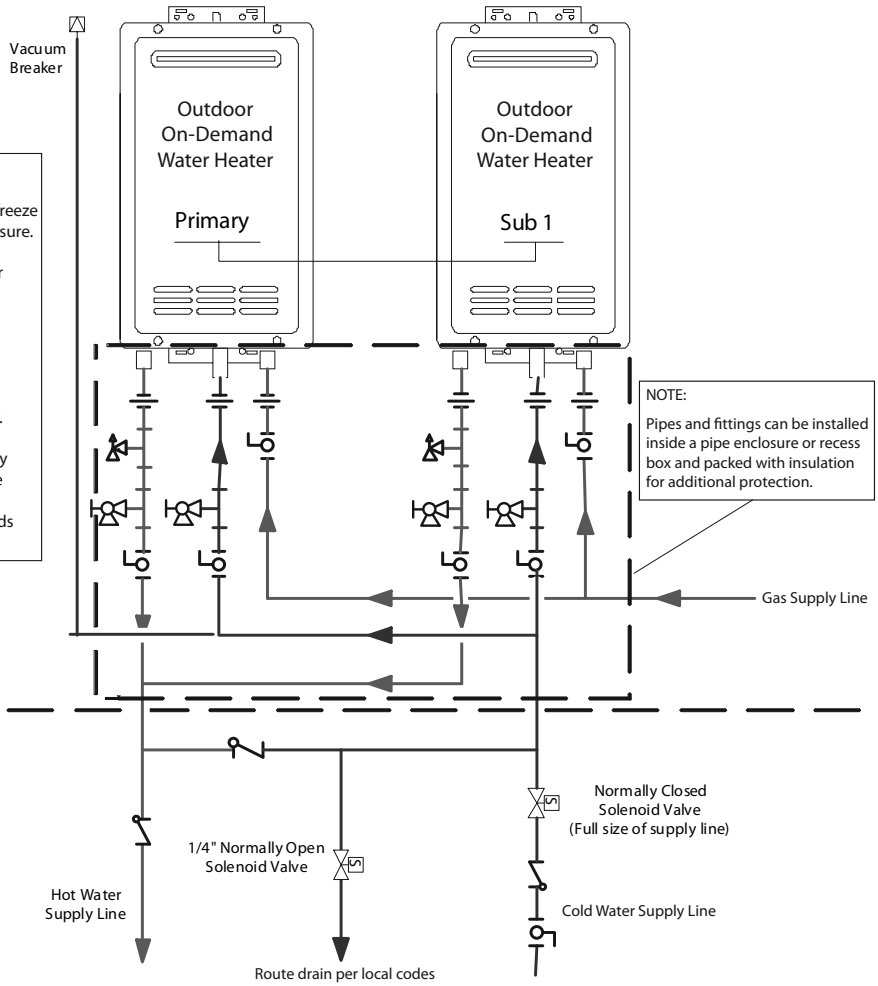
When the electrical power to the water heater fails, the cold water supply solenoid valve closes, stopping the flow of water into the heater, and the drain down solenoid valve opens, allowing the water heater and associated piping to drain. Ensure that you run the drain for the solenoids per local codes.

NOTE:

Freeze protect all water pipes and fittings located outside building structure. These are indicated by being above the dashed line.

All pipes and fittings shown below the dashed line should be located inside the building structure.

The vacuum breaker line should be located inside the building structure.


Vacuum Breaker
Outdoor On-Demand Water Heater
Primary
Outdoor On-Demand Water Heater
Sub 1
NOTE:
Pipes and fittings can be installed inside a pipe enclosure or recess box and packed with insulation for additional protection.
Gas Supply Line
Normally Closed Solenoid Valve (Full size of supply line)
1/4" Normally Open Solenoid Valve
Hot Water Supply Line
Cold Water Supply Line
Route drain per local codes

Domestic Hot Water - Optional Freeze Protection
2 Outdoor On-Demand Water Heaters
Preferred Piping Installation

Key

3/4" Ball Valve
3/4" Union
Check Valve
Pressure Relief Valve
Pressure Regulator
Circulating Pump
Boiler Drain Valve
Solenoid Valve
Mixing Valve

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Drawing Date: September 07, 2008

Drawing Number: H-2-E

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IMPORTANT!

With electrical power supplied to a on-demand water heater, it will not freeze in enviornments as cold as -30^0 F, when protected from direct wind exposure.

In the event of a power failure at temperatures below freezing, the water heater should be drained of all water to prevent freezing damage.

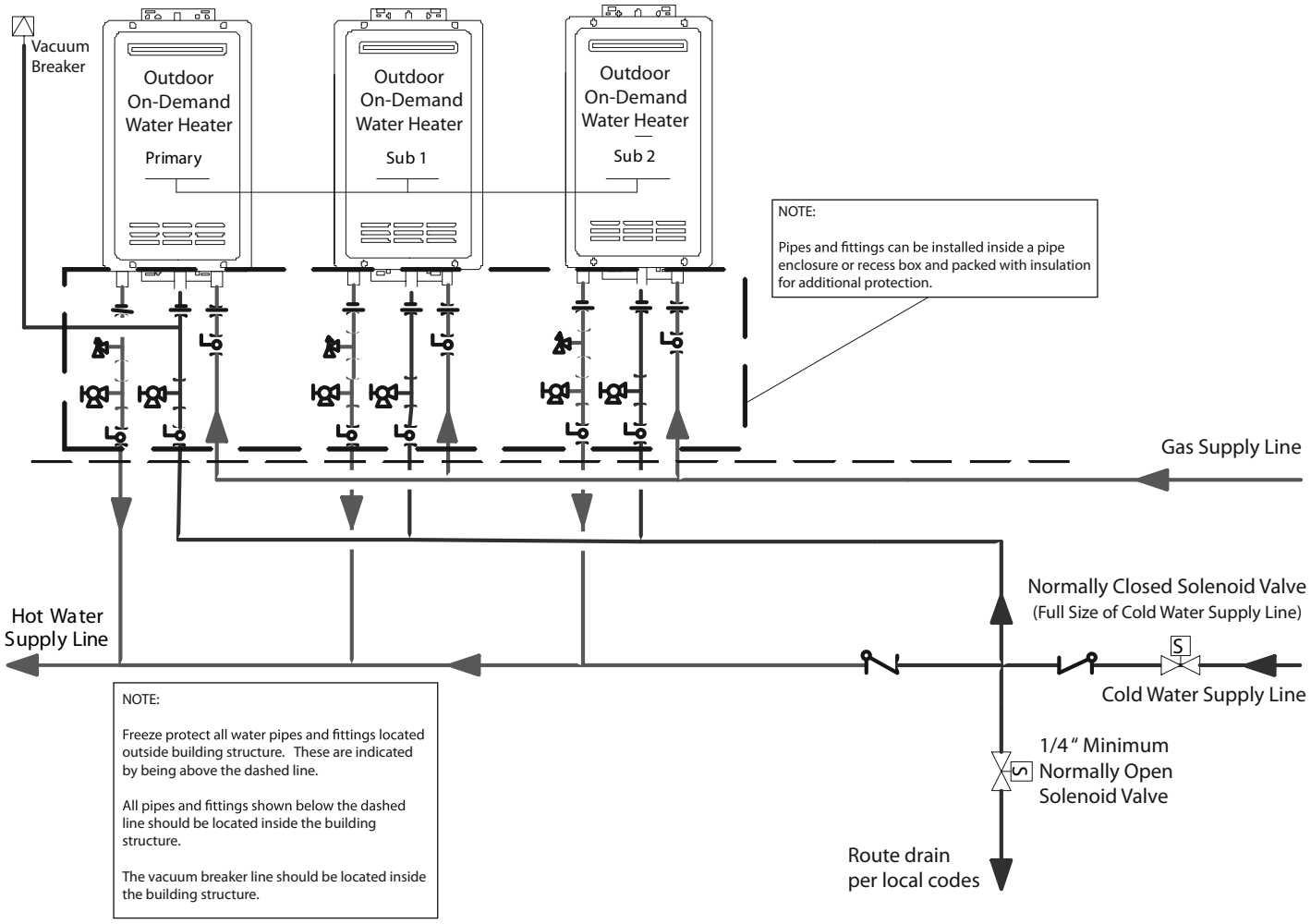
The unit may be drained manually or through the installation of the Optional solenoid valves as shown.

The electrical connections for the two solenoid valves should be tied to the 120V power terminals provided on the PC Board of the water heater.

When the electrical power to the water heater fails, the cold water supply solenoid valve closes, stopping the flow of water into the heater, and the drain down solenoid valve opens, allowing the water heater and associated piping to drain. Ensure that you run the drain for the solenoids per local codes.

On-Demand Equipment List	QTY
On-Demand Outdoor Water Heaters	3
Electronic Connection *	

* Refer to On-Demand Accessories and Model Applicability for electronic connection details.


Vacuum Breaker
Outdoor On-Demand Water Heater
Primary
Outdoor On-Demand Water Heater
Sub 1
Outdoor On-Demand Water Heater
Sub 2
NOTE:
Pipes and fittings can be installed inside a pipe enclosure or recess box and packed with insulation for additional protection.
Gas Supply Line
Hot Water Supply Line
Normally Closed Solenoid Valve
(Full Size of Cold Water Supply Line)
Cold Water Supply Line
1/4" Minimum Normally Open Solenoid Valve
Route drain per local codes
NOTE:
Freeze protect all water pipes and fittings located outside building structure. These are indicated by being above the dashed line.
All pipes and fittings shown below the dashed line should be located inside the building structure.
The vacuum breaker line should be located inside the building structure.

Domestic Hot Water - Optional Freeze Protection
3 Outdoor On-Demand Water Heater
Preferred Piping Installation

Key

3/4" Ball Valve
3/4" Union
Check Valve
Pressure Relief Valve
Pressure Regulator
Circulating Pump
Boiler Drain Valve
Solenoid Valve
Mixing Valve

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Drawing Date: September 07, 2008

Drawing Number: H-3-E

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IMPORTANT!

With electrical power supplied to a on-demand water heater, it will not freeze in enviornments as cold as -30º F, when protected from direct wind exposure.

In the event of a power failure at temperatures below freezing, the water heater should be drained of all water to prevent freezing damage.

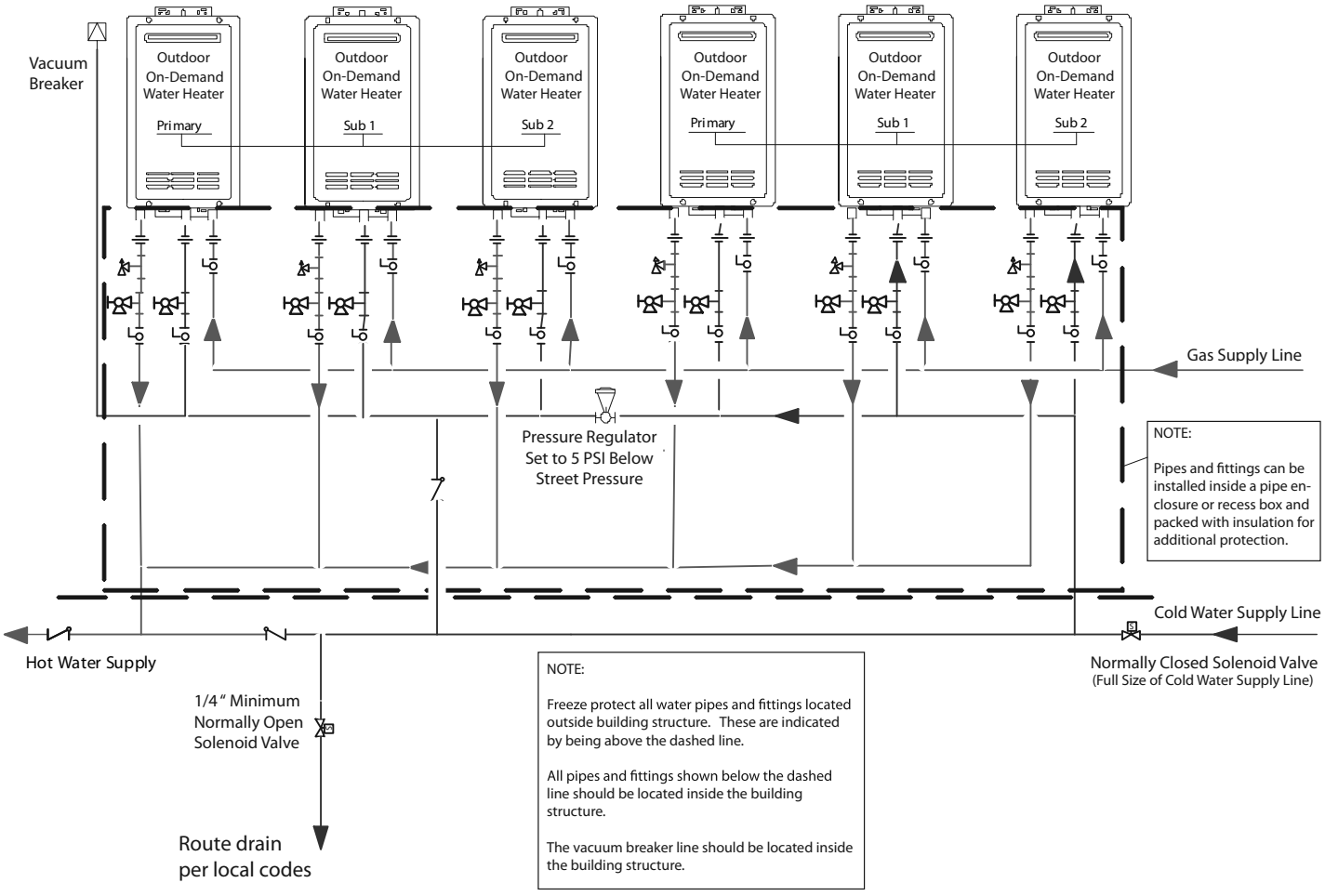
The unit may be drained manually or through the installation of the Optional solenoid valves as shown.

The electrical connections for the two solenoid valves should be tied to the 120V power terminals provided on the PC Board of the water heater.

When the electrical power to the water heater fails, the cold water supply solenoid valve closes, stopping the flow of water into the heater, and the drain down solenoid valve opens, allowing the water heater and associated piping to drain. Ensure that you run the drain for the solenoids per local codes.

On-Demand Equipment List	QTY
On-Demand Outdoor Water Heaters	6
Electronic Connection *	

* Refer to On-Demand Accessories and Model Applicability for electronic connection details.


Vacuum Breaker
Outdoor On-Demand Water Heater
Primary
Outdoor On-Demand Water Heater
Sub 1
Outdoor On-Demand Water Heater
Sub 2
Outdoor On-Demand Water Heater
Primary
Outdoor On-Demand Water Heater
Sub 1
Outdoor On-Demand Water Heater
Sub 2
Gas Supply Line
Pressure Regulator Set to 5 PSI Below Street Pressure
NOTE:
Pipes and fittings can be installed inside a pipe enclosure or recess box and packed with insulation for additional protection.
Cold Water Supply Line
Hot Water Supply
Normally Closed Solenoid Valve
(Full Size of Cold Water Supply Line)
1/4" Minimum Normally Open Solenoid Valve
Route drain per local codes
NOTE:
Freeze protect all water pipes and fittings located outside building structure. These are indicated by being above the dashed line.
All pipes and fittings shown below the dashed line should be located inside the building structure.
The vacuum breaker line should be located inside the building structure.

Domestic Hot Water - Optional Freeze Protection
6 Outdoor On-Demand Water Heater
Preferred Piping Installation

Key

3/4" Ball Valve
3/4" Union
Check Valve
Pressure Relief Valve
Pressure Regulator
Circulating Pump
Boiler Drain Valve
Solenoid Valve
Mixing Valve

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Drawing Date: September 07, 2008

Drawing Number: H-6-E

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For this application:

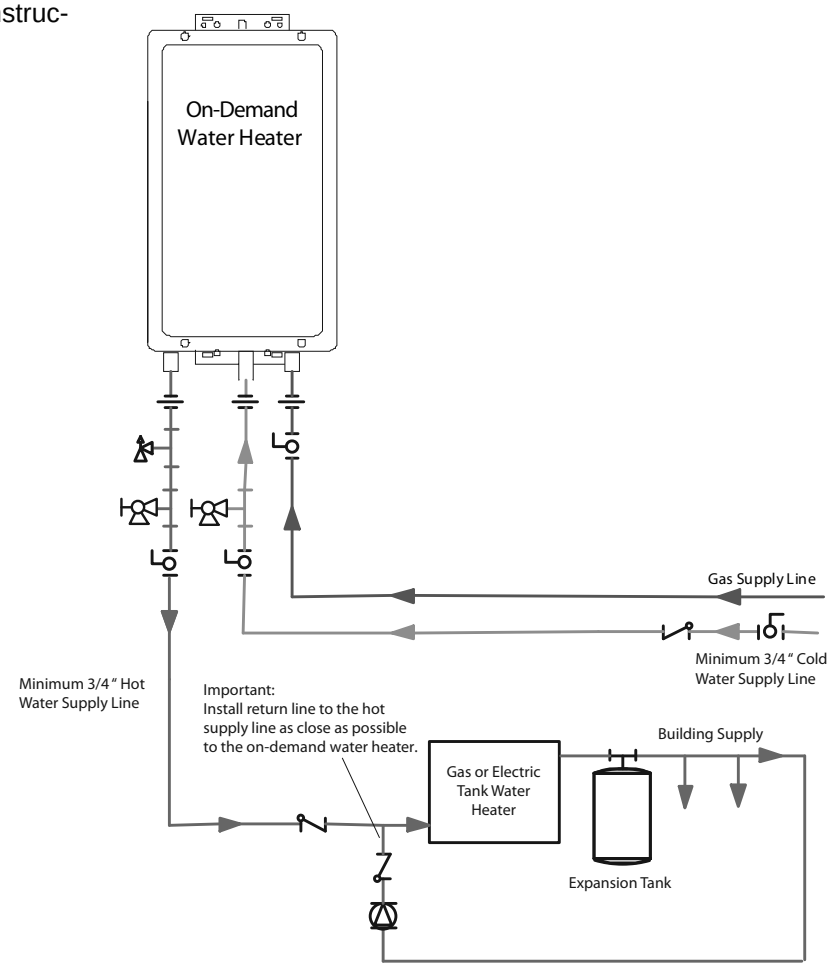
Pump should be controlled by an Aquastat, Timer or Combination Aquastat and Timer.

Pump to be sized to maintain circulation loop temperature.

The pump should be sized to overcome the pressure loss through the tank water heater, and supply and return plumbing in the circulation loop. Reference the section *Pump Sizing for Circulation*.

Pump to be of bronze or stainless construction.

On-Demand Equipment List	QTY
On-Demand Water Heater	1



Domestic Hot Water - Circulation Systems
1 On-Demand Water Heater with Gas or Electric Tank
Preferred Piping Installation

Key

3/4" Ball Valve | Check Valve | Pressure Regulator | Boiler Drain Valve
3/4" Union | Pressure Relief Valve | Circulating Pump | Solenoid Valve | Mixing Valve

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Drawing Date: September 07, 2008

Drawing Number: H-1-RP

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For this application:

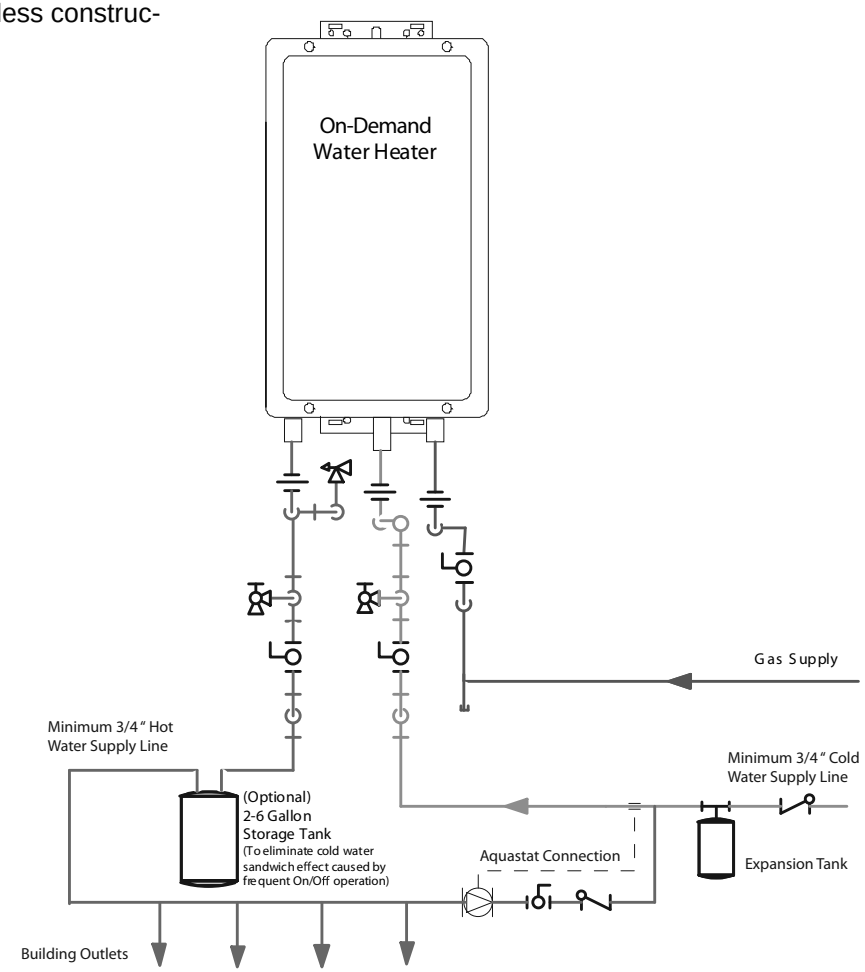
Pump should be controlled by an Aquastat, Timer or Combination Aquastat and Timer.

Pump to be sized to maintain circulation loop temperature.

The pump should be sized to overcome the pressure loss through the tank water heater, and supply and return plumbing in the circulation loop. Reference the section *Pump Sizing for Circulation*.

Pump to be of bronze or stainless construction.

On-Demand Equipment List	QTY
On-Demand Water Heater	1



Domestic Hot Water - Circulation Systems
1 On-Demand Water Heater
Optional Piping Installation

Key

3/4" Ball Valve
3/4" Union
Check Valve
Pressure Relief Valve
Pressure Regulator
Circulating Pump
Boiler Drain Valve
Solenoid Valve
Mixing Valve

NOTE: This drawing is not intended to describe a complete system and is not a replacement for a professional engineering drawing. It is intended only as a guide and does not imply compliance with local building code requirements. Confer with local building officials before installation. The Contractor or engineer is to determine the necessary components and configuration of the particular system to be installed. It is the responsibility of the engineer or contractor to ensure that the installation is in accordance with all local building codes.

Drawing Date: September 07, 2008

Drawing Number: H-1-RO

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For this application:

Pump should be controlled by an Aquastat, Timer or Combination Aquastat and Timer.

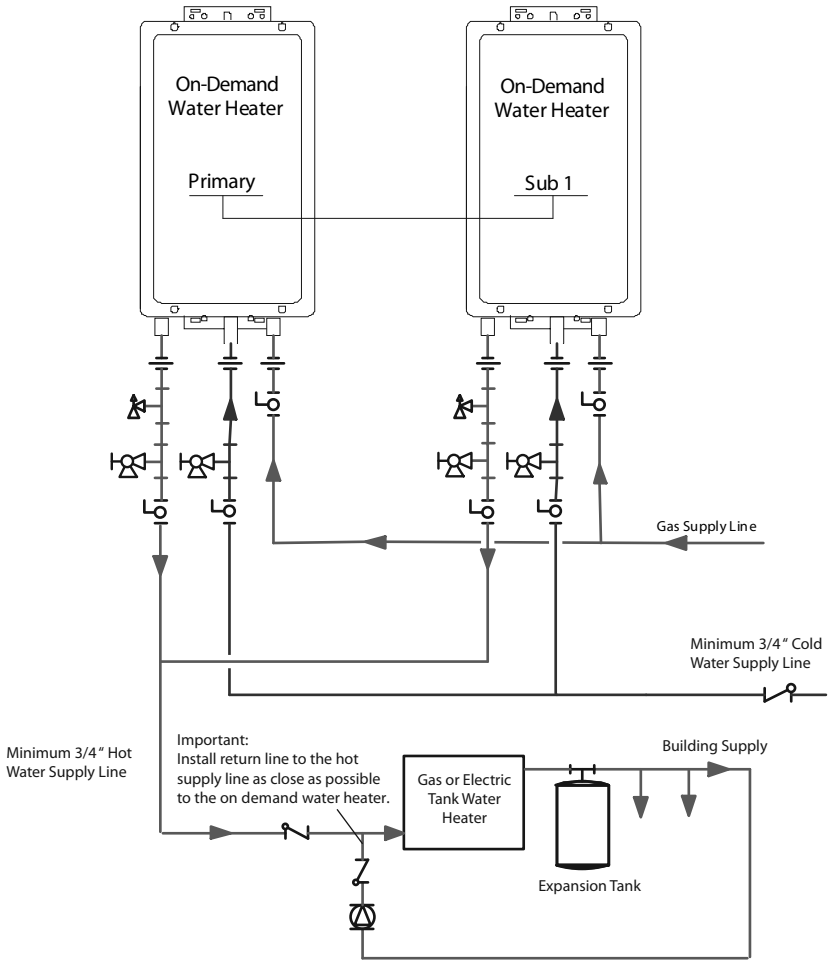
Pump to be sized to maintain circulation loop temperature.

The pump should be sized to overcome the pressure loss through the tank water heater, and supply and return plumbing in the circulation loop. Reference the section *Pump Sizing for Circulation*.

Pump to be of bronze or stainless construction.

On-Demand Equipment List	QTY
On-Demand Water Heaters	2
Electronic Connection *	

* Refer to On-Demand Accessories and Model Applicability for electronic connection details.


On-Demand Water Heater
Primary
On-Demand Water Heater
Sub 1
Gas Supply Line
Minimum 3/4" Cold Water Supply Line
Minimum 3/4" Hot Water Supply Line
Important:
Install return line to the hot supply line as close as possible to the on demand water heater.
Gas or Electric Tank Water Heater
Building Supply
Expansion Tank

Domestic Hot Water - Circulation Systems
2 On-Demand Water Heaters with Gas or Electric Tank
Preferred Piping Installation

Key

3/4" Ball Valve | Check Valve | Pressure Regulator | Boiler Drain Valve | Mixing Valve

3/4" Union | Pressure Relief Valve | Circulating Pump | Solenoid Valve

NOTE: This drawing is not intended to describe a complete system and is not a replacement for a professional engineering drawing. It is intended only as a guide and does not imply compliance with local building code requirements. Confer with local building officials before installation. The Contractor or engineer is to determine the necessary components and configuration of the particular system to be installed. It is the responsibility of the engineer or contractor to ensure that the installation is in accordance with all local building codes.

Drawing Date: September 07, 2008

Drawing Number: H-2-RP

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For this application:

Pump should be controlled by an Aquastat, Timer or Combination Aquastat and Timer.

Pump to be sized to maintain circulation loop temperature.

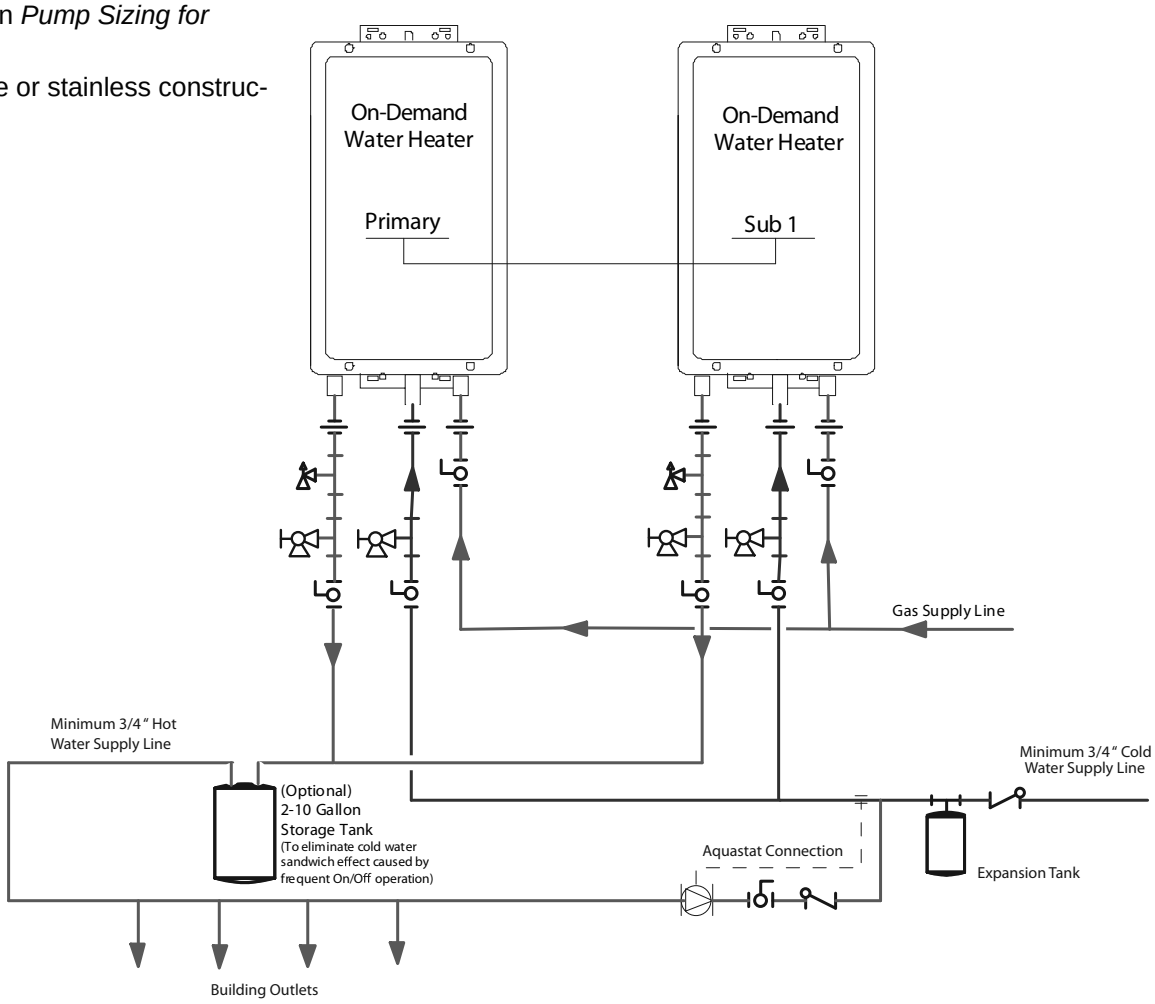
A minimum of 3 GPM flow is recommended for the circulation system.

The pump should be sized to overcome the pressure loss through the on demand water heater, optional storage tank, and supply and return plumbing in the circulation loop. Reference the section *Pump Sizing for Circulation*.

Pump to be of bronze or stainless construction.

On-Demand Equipment List	QTY
On-Demand Water Heaters	2
Electronic Connection *	

* Refer to On-Demand Accessories and Model Applicability for electronic connection details.



Domestic Hot Water - Circulation Systems
2 On-Demand Water Heater
Optional Piping Installation

Key

3/4" Ball Valve
3/4" Union
Check Valve
Pressure Relief Valve
Pressure Regulator
Circulating Pump
Boiler Drain Valve
Solenoid Valve
Mixing Valve

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Drawing Date: September 07, 2008

Drawing Number: H-2-RO

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For this application:

Pump should be controlled by an Aquastat, Timer or Combination Aquastat and Timer.

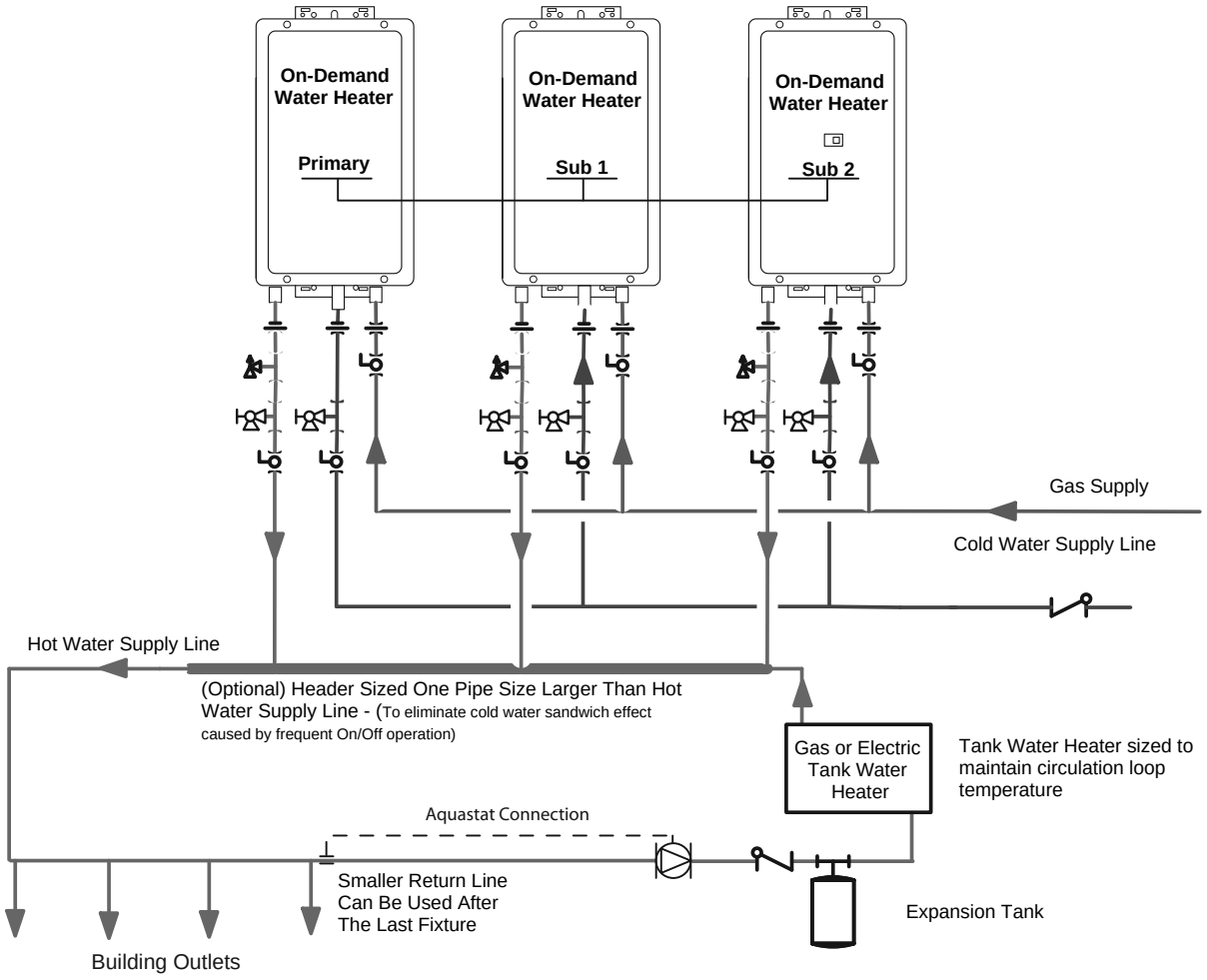
Pump to be sized to maintain circulation loop temperature.

The pump should be sized to overcome the pressure loss through the tank water heater, and supply and return plumbing in the circulation loop. Reference the section *Pump Sizing for Circulation*.

Pump to be of bronze or stainless construction.

On-Demand Equipment List	QTY
On-Demand Water Heaters	3
Electronic Connection *	

* Refer to On-Demand Accessories and Model Applicability for electronic connection details.


On-Demand Water Heater
Primary
On-Demand Water Heater
Sub 1
On-Demand Water Heater
Sub 2
Gas Supply
Cold Water Supply Line
Hot Water Supply Line
(Optional) Header Sized One Pipe Size Larger Than Hot Water Supply Line - (To eliminate cold water sandwich effect caused by frequent On/Off operation)
Gas or Electric Tank Water Heater
Tank Water Heater sized to maintain circulation loop temperature
Aquastat Connection
Smaller Return Line Can Be Used After The Last Fixture
Expansion Tank
Building Outlets

Domestic Hot Water - Circulation Systems
3 On-Demand Water Heaters with Gas or Electric Tank
Preferred Piping Installation

Key

3/4" Ball Valve | Check Valve | Pressure Regulator | Boiler Drain Valve
3/4" Union | Pressure Relief Valve | Circulating Pump | Solenoid Valve | Mixing Valve

NOTE: This drawing is not intended to describe a complete system and is not a replacement for a professional engineering drawing. It is intended only as a guide and does not imply compliance with local building code requirements. Confer with local building officials before installation. The Contractor or engineer is to determine the necessary components and configuration of the particular system to be installed. It is the responsibility of the engineer or contractor to ensure that the installation is in accordance with all local building codes.

Drawing Date: September 07, 2008

Drawing Number: H-3-RP

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For this application:

Pump should be controlled by an Aquastat, Timer or Combination Aquastat and Timer.

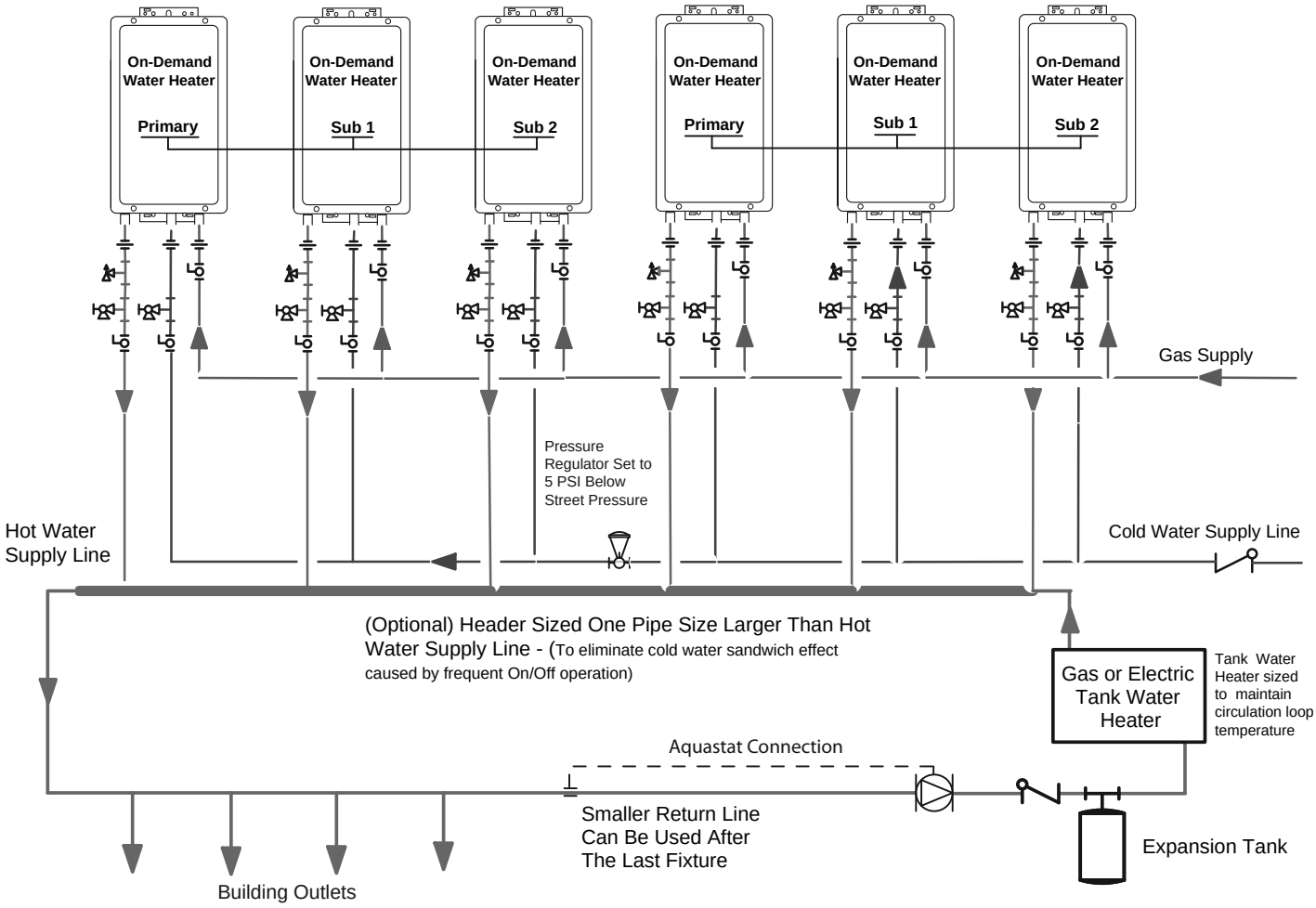
Pump to be sized to maintain circulation loop temperature.

The pump should be sized to overcome the pressure loss through the tank water heater, and supply and return plumbing in the circulation loop. Reference the section *Pump Sizing for Circulation*.

Pump to be of bronze or stainless construction.

On-Demand Equipment List	QTY
On-Demand Water Heaters	6
Electronic Connection *	

* Refer to On-Demand Accessories and Model Applicability for electronic connection details.


On-Demand Water Heater
Primary
On-Demand Water Heater
Sub 1
On-Demand Water Heater
Sub 2
On-Demand Water Heater
Primary
On-Demand Water Heater
Sub 1
On-Demand Water Heater
Sub 2
Gas Supply
Pressure Regulator Set to 5 PSI Below Street Pressure
Hot Water Supply Line
Cold Water Supply Line
(Optional) Header Sized One Pipe Size Larger Than Hot Water Supply Line - (To eliminate cold water sandwich effect caused by frequent On/Off operation)
Gas or Electric Tank Water Heater
Tank Water Heater sized to maintain circulation loop temperature
Aquastat Connection
Smaller Return Line Can Be Used After The Last Fixture
Expansion Tank
Building Outlets

Domestic Hot Water - Circulation Systems
6 On-Demand Water Heaters with Gas or Electric Tank
Preferred Piping Installation

Key

3/4" Ball Valve | Check Valve | Pressure Regulator | Boiler Drain Valve
3/4" Union | Pressure Relief Valve | Circulating Pump | Solenoid Valve | Mixing Valve

NOTE: This drawing is not intended to describe a complete system and is not a replacement for a professional engineering drawing. It is intended only as a guide and does not imply compliance with local building code requirements. Confer with local building officials before installation. The Contractor or engineer is to determine the necessary components and configuration of the particular system to be installed. It is the responsibility of the engineer or contractor to ensure that the installation is in accordance with all local building codes.

Drawing Date: September 07, 2008

Drawing Number: H-6-RP

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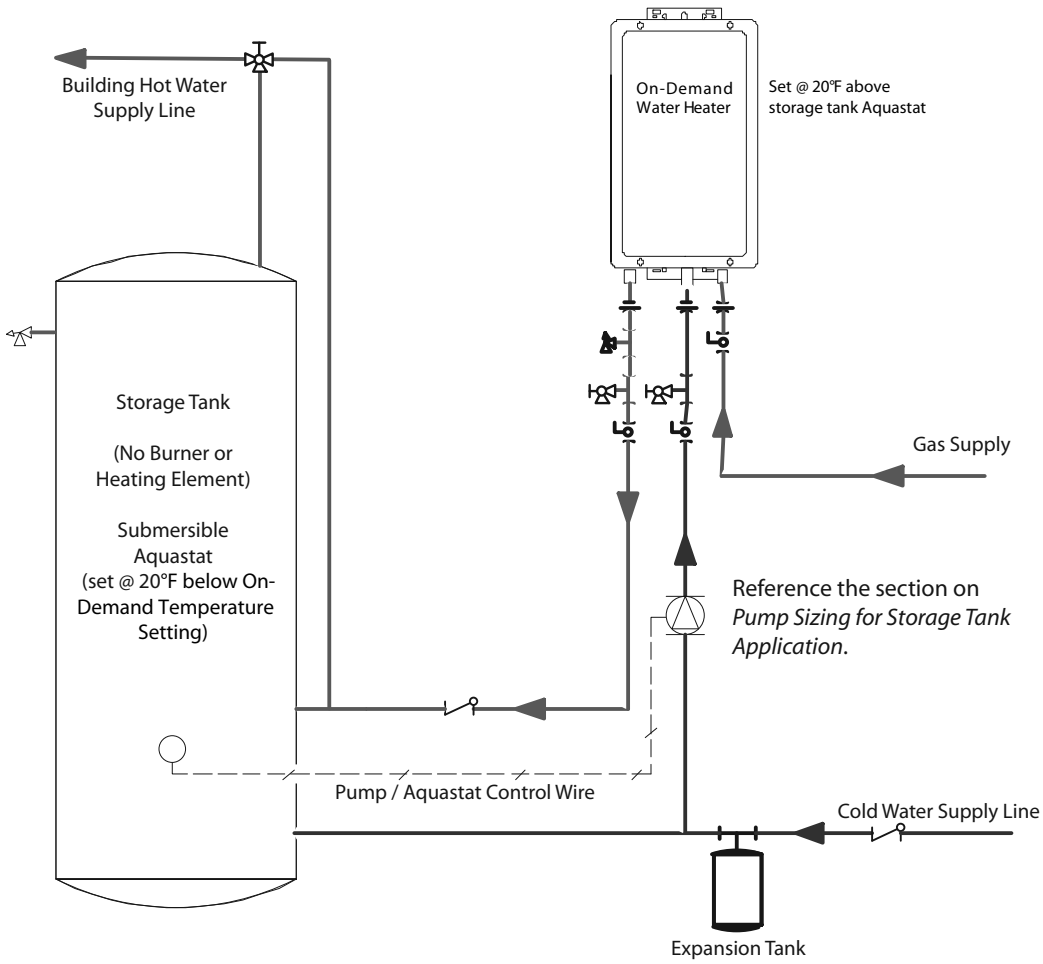
On-Demand Equipment List	QTY
On-Demand Water Heaters	1


Building Hot Water Supply Line
On-Demand Water Heater
Set @ 20°F above storage tank Aquastat
Storage Tank
(No Burner or Heating Element)
Submersible Aquastat (set @ 20°F below On-Demand Temperature Setting)
Gas Supply
Reference the section on *Pump Sizing for Storage Tank Application*.
Pump / Aquastat Control Wire
Cold Water Supply Line
Expansion Tank

Domestic Hot Water - Backup Storage
1 On-Demand Water Heater
Preferred Piping Installation

Key

3/4" Ball Valve | Check Valve | Pressure Regulator | Boiler Drain Valve
3/4" Union | Pressure Relief Valve | Circulating Pump | Solenoid Valve | Mixing Valve

NOTE: This drawing is not intended to describe a complete system and is not a replacement for a professional engineering drawing. It is intended only as a guide and does not imply compliance with local building code requirements. Confer with local building officials before installation. The Contractor or engineer is to determine the necessary components and configuration of the particular system to be installed. It is the responsibility of the engineer or contractor to ensure that the installation is in accordance with all local building codes.

Drawing Date: September 07, 2008

Drawing Number: H-1-T

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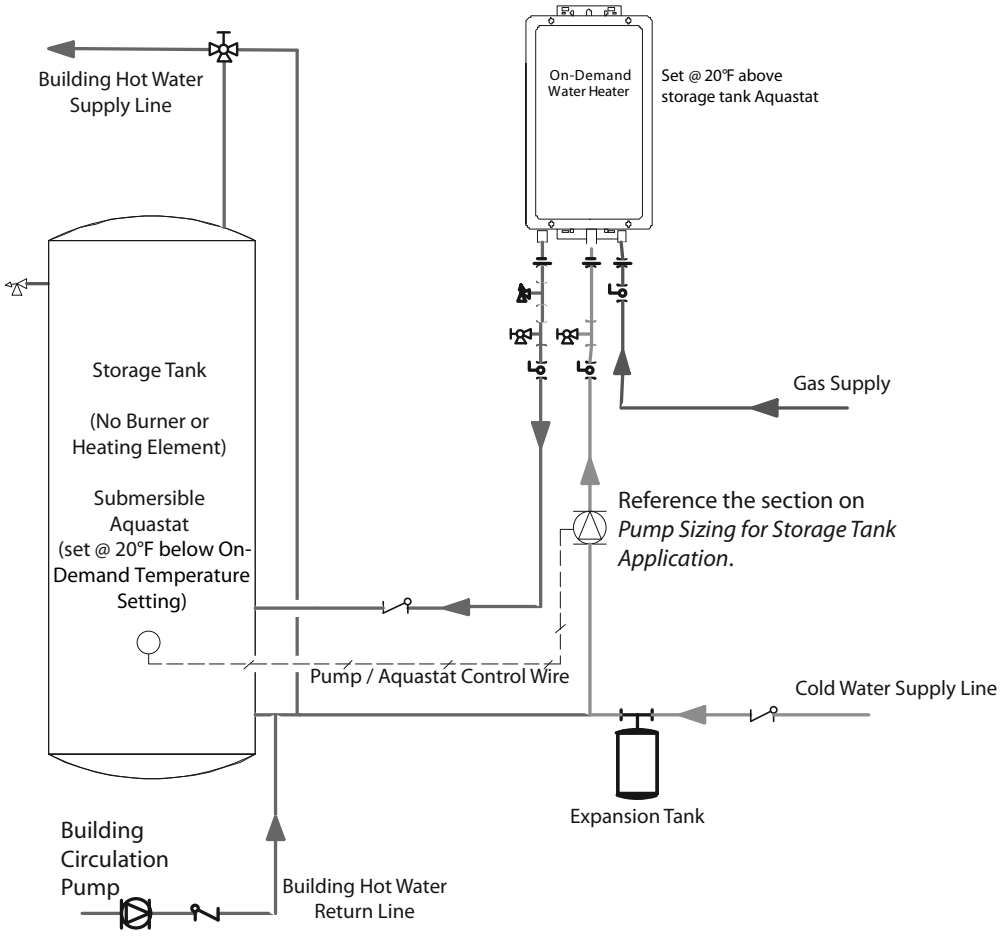
On-Demand Equipment List	QTY
On-Demand Water Heater	1


Building Hot Water Supply Line
On-Demand Water Heater
Set @ 20°F above storage tank Aquastat
Storage Tank
(No Burner or Heating Element)
Submersible Aquastat (set @ 20°F below On-Demand Temperature Setting)
Gas Supply
Reference the section on *Pump Sizing for Storage Tank Application*.
Pump / Aquastat Control Wire
Cold Water Supply Line
Expansion Tank
Building Circulation Pump
Building Hot Water Return Line

Domestic Hot Water - Backup Storage / Circulation
1 On-Demand Water Heater
Preferred Piping Installation

Key

- 3/4" Ball Valve
- 3/4" Union
- Check Valve
- Pressure Relief Valve
- Pressure Regulator
- Circulating Pump
- Boiler Drain Valve
- Solenoid Valve
- Mixing Valve

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Drawing Date: September 07, 2008

Drawing Number: H-1-TC

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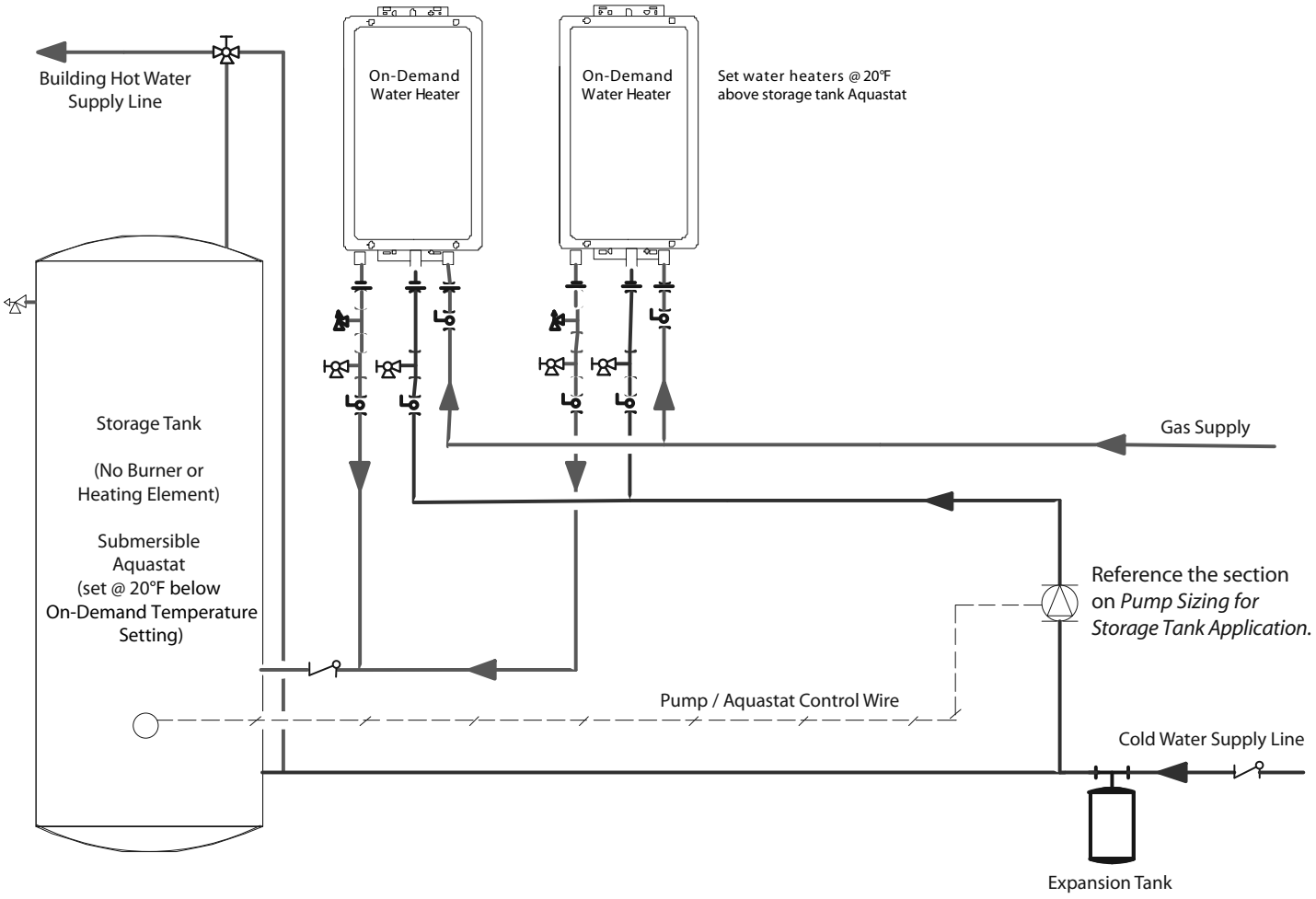
On-Demand Equipment List	QTY
On-Demand Commercial Water Heaters	2


Building Hot Water Supply Line
On-Demand Water Heater
On-Demand Water Heater
Set water heaters @ 20°F above storage tank Aquastat
Storage Tank
(No Burner or Heating Element)
Submersible Aquastat (set @ 20°F below On-Demand Temperature Setting)
Gas Supply
Reference the section on *Pump Sizing for Storage Tank Application.*
Pump / Aquastat Control Wire
Cold Water Supply Line
Expansion Tank

Domestic Hot Water - Backup Storage
2 On-Demand Water Heater
Preferred Piping Installation

Key

3/4" Ball Valve
3/4" Union
Check Valve
Pressure Relief Valve
Pressure Regulator
Circulating Pump
Boiler Drain Valve
Solenoid Valve
Mixing Valve

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Drawing Date: September 07, 2008

Drawing Number: H-2-T

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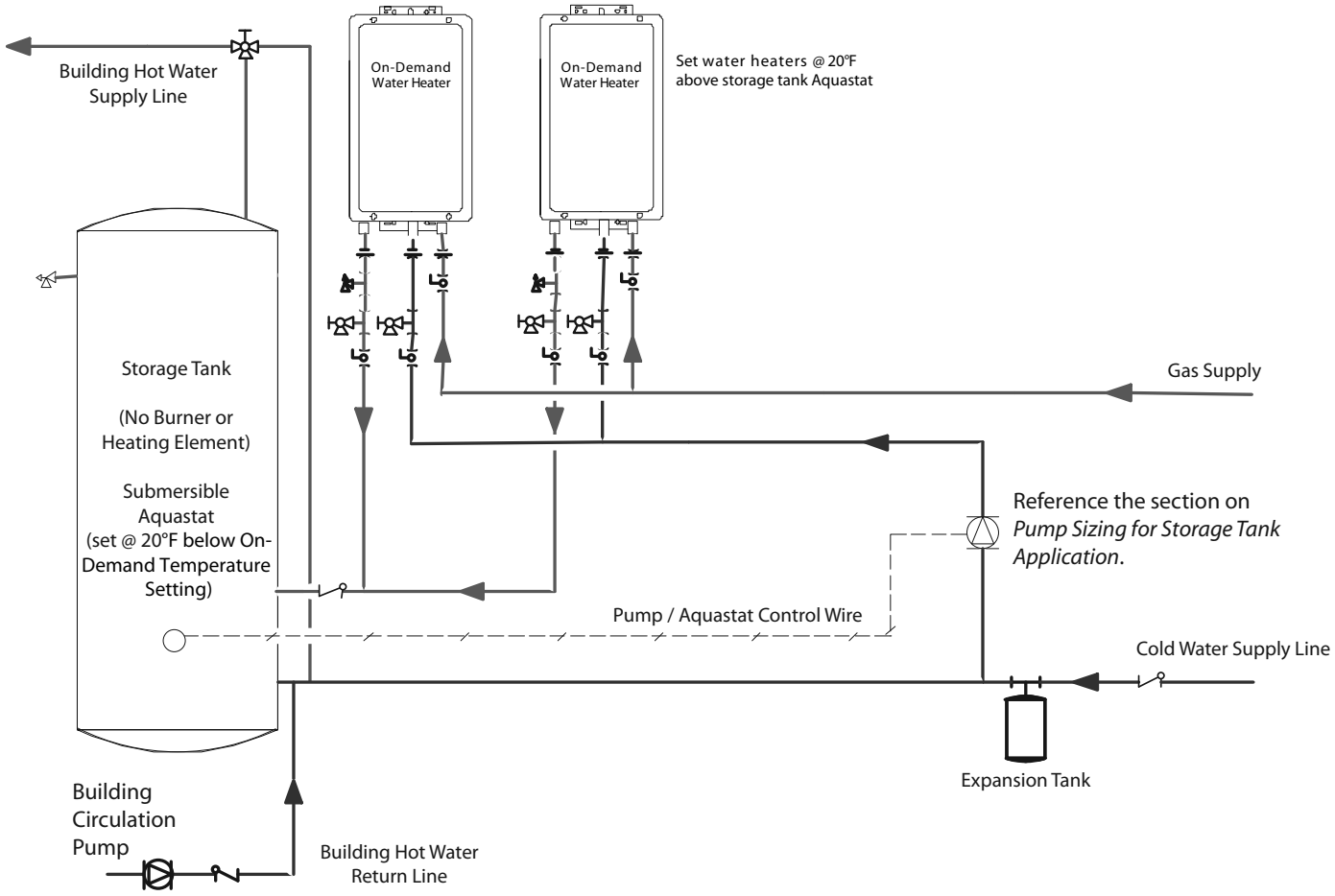
On-Demand Equipment List	QTY
On-Demand Commercial Water Heaters	2


Building Hot Water Supply Line
On-Demand Water Heater
On-Demand Water Heater
Set water heaters @ 20°F above storage tank Aquastat
Storage Tank
(No Burner or Heating Element)
Submersible Aquastat (set @ 20°F below On-Demand Temperature Setting)
Gas Supply
Reference the section on *Pump Sizing for Storage Tank Application*.
Pump / Aquastat Control Wire
Cold Water Supply Line
Expansion Tank
Building Circulation Pump
Building Hot Water Return Line

Domestic Hot Water - Backup Storage / Circulation
2 On-Demand Water Heater
Preferred Piping Installation

Key

- 3/4" Ball Valve
- 3/4" Union
- Check Valve
- Pressure Relief Valve
- Pressure Regulator
- Circulating Pump
- Boiler Drain Valve
- Solenoid Valve
- Mixing Valve

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Drawing Date: September 07, 2008

Drawing Number: H-2-TC

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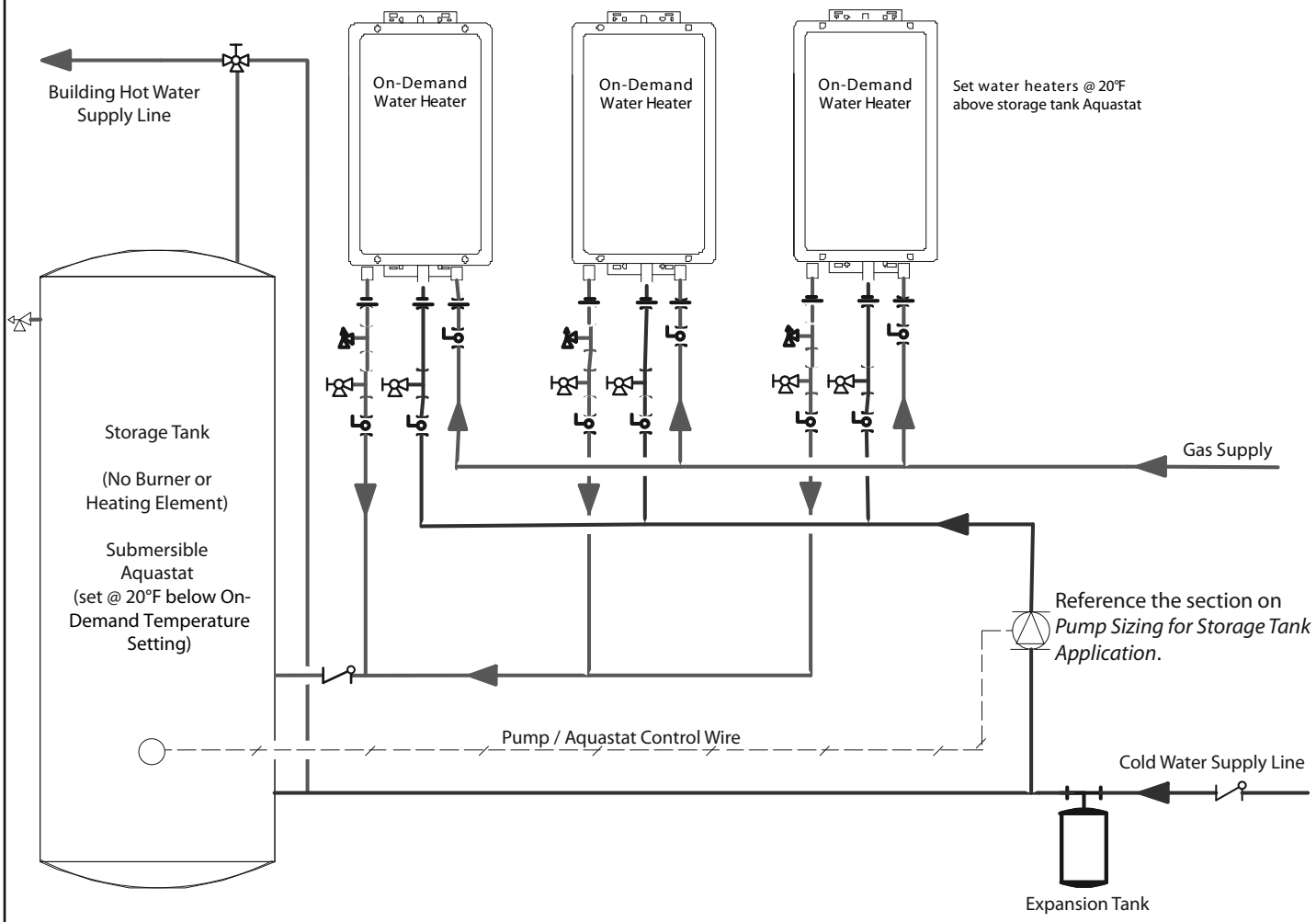
On-Demand Equipment List	QTY
On-Demand Water Heaters	3


Building Hot Water Supply Line
On-Demand Water Heater
On-Demand Water Heater
On-Demand Water Heater
Set water heaters @ 20°F above storage tank Aquastat
Storage Tank
(No Burner or Heating Element)
Submersible Aquastat (set @ 20°F below On-Demand Temperature Setting)
Gas Supply
Reference the section on *Pump Sizing for Storage Tank Application*.
Pump / Aquastat Control Wire
Cold Water Supply Line
Expansion Tank

Domestic Hot Water - Backup Storage
3 On-Demand Water Heaters
Preferred Piping Installation

Key

- 3/4" Ball Valve
- 3/4" Union
- Check Valve
- Pressure Relief Valve
- Pressure Regulator
- Circulating Pump
- Boiler Drain Valve
- Solenoid Valve
- Mixing Valve

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Drawing Date: September 07, 2008

Drawing Number: H-3-T

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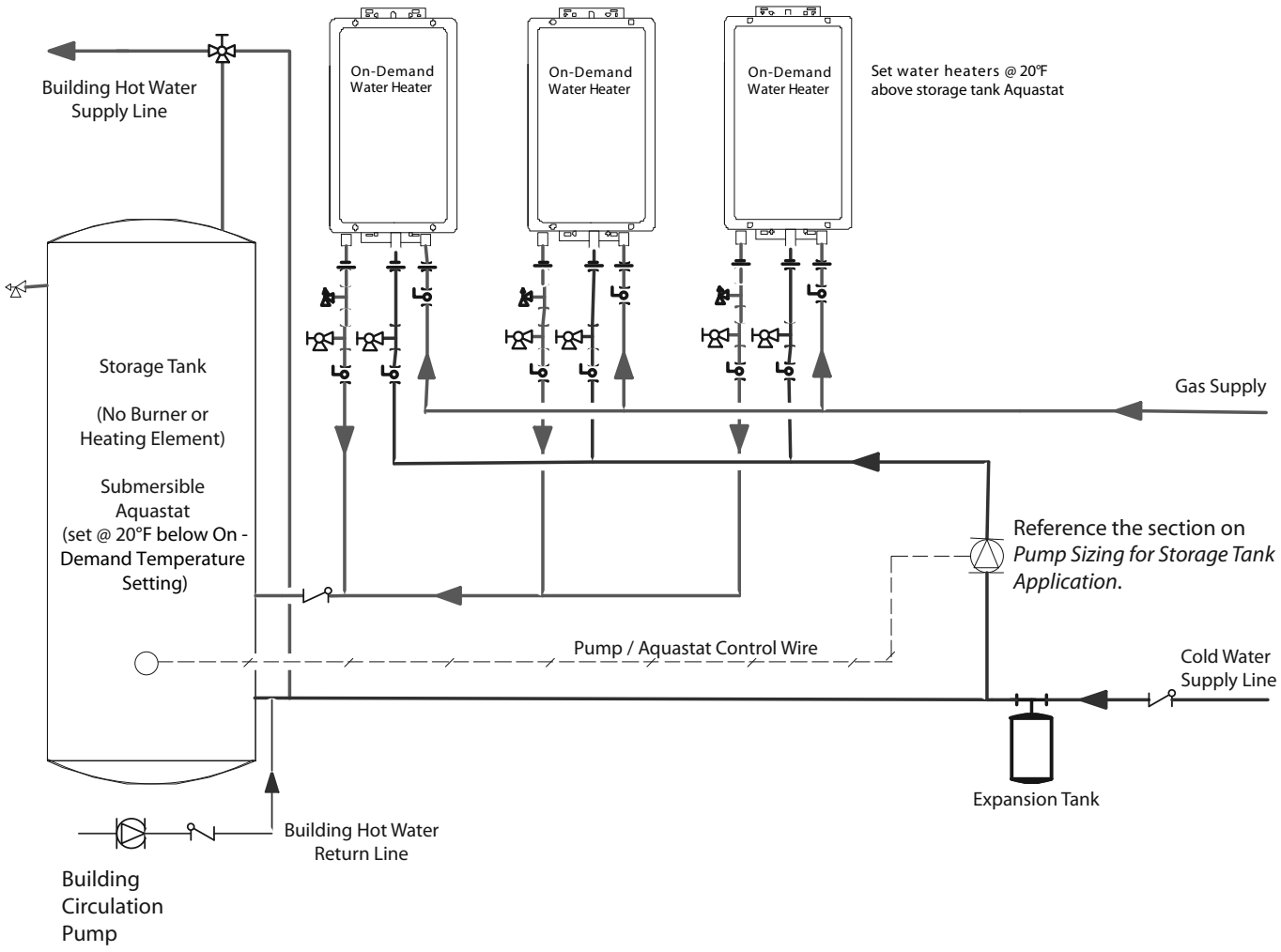
On-Demand Equipment List	QTY
On-Demand Water Heaters	3


Building Hot Water Supply Line
On-Demand Water Heater
On-Demand Water Heater
On-Demand Water Heater
Set water heaters @ 20°F above storage tank Aquastat
Storage Tank
(No Burner or Heating Element)
Submersible Aquastat (set @ 20°F below On - Demand Temperature Setting)
Gas Supply
Reference the section on *Pump Sizing for Storage Tank Application*.
Pump / Aquastat Control Wire
Cold Water Supply Line
Expansion Tank
Building Hot Water Return Line
Building Circulation Pump

Domestic Hot Water - Backup Storage / Circulation
3 On-Demand Water Heaters
Preferred Piping Installation

Key

- 3/4" Ball Valve
- 3/4" Union
- Check Valve
- Pressure Relief Valve
- Pressure Regulator
- Circulating Pump
- Boiler Drain Valve
- Solenoid Valve
- Mixing Valve

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Drawing Date: September 07, 2008

Drawing Number: H-3-TC

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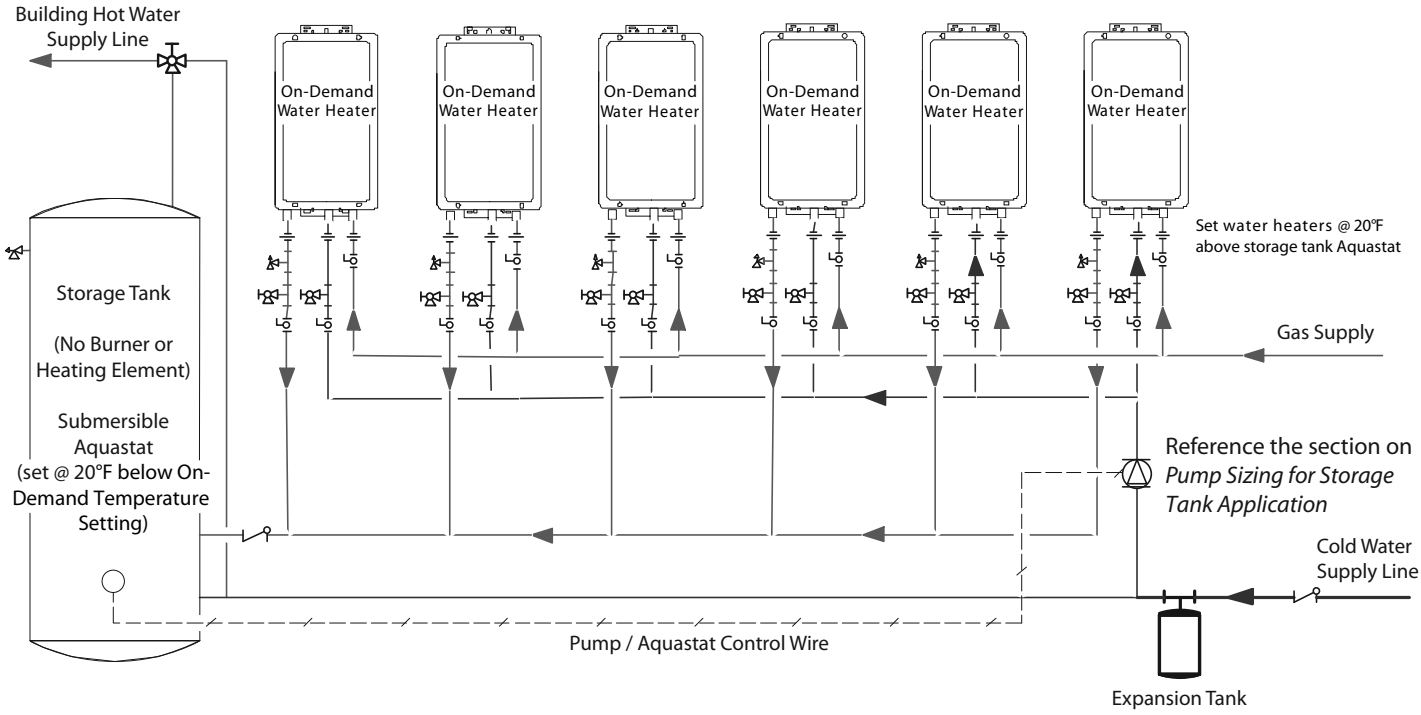
On-Demand Equipment List	QTY
On-Demand Water Heaters	6


Building Hot Water Supply Line
On-Demand Water Heater
On-Demand Water Heater
On-Demand Water Heater
On-Demand Water Heater
On-Demand Water Heater
On-Demand Water Heater
Set water heaters @ 20°F above storage tank Aquastat
Storage Tank
(No Burner or Heating Element)
Submersible Aquastat (set @ 20°F below On-Demand Temperature Setting)
Gas Supply
Reference the section on *Pump Sizing for Storage Tank Application*
Cold Water Supply Line
Pump / Aquastat Control Wire
Expansion Tank

Domestic Hot Water - Backup Storage
6 On-Demand Water Heaters
Preferred Piping Installation

Key

- 3/4" Ball Valve
- 3/4" Union
- Check Valve
- Pressure Relief Valve
- Pressure Regulator
- Circulating Pump
- Boiler Drain Valve
- Solenoid Valve
- Mixing Valve

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Drawing Date: September 07, 2008

Drawing Number: H-6-T

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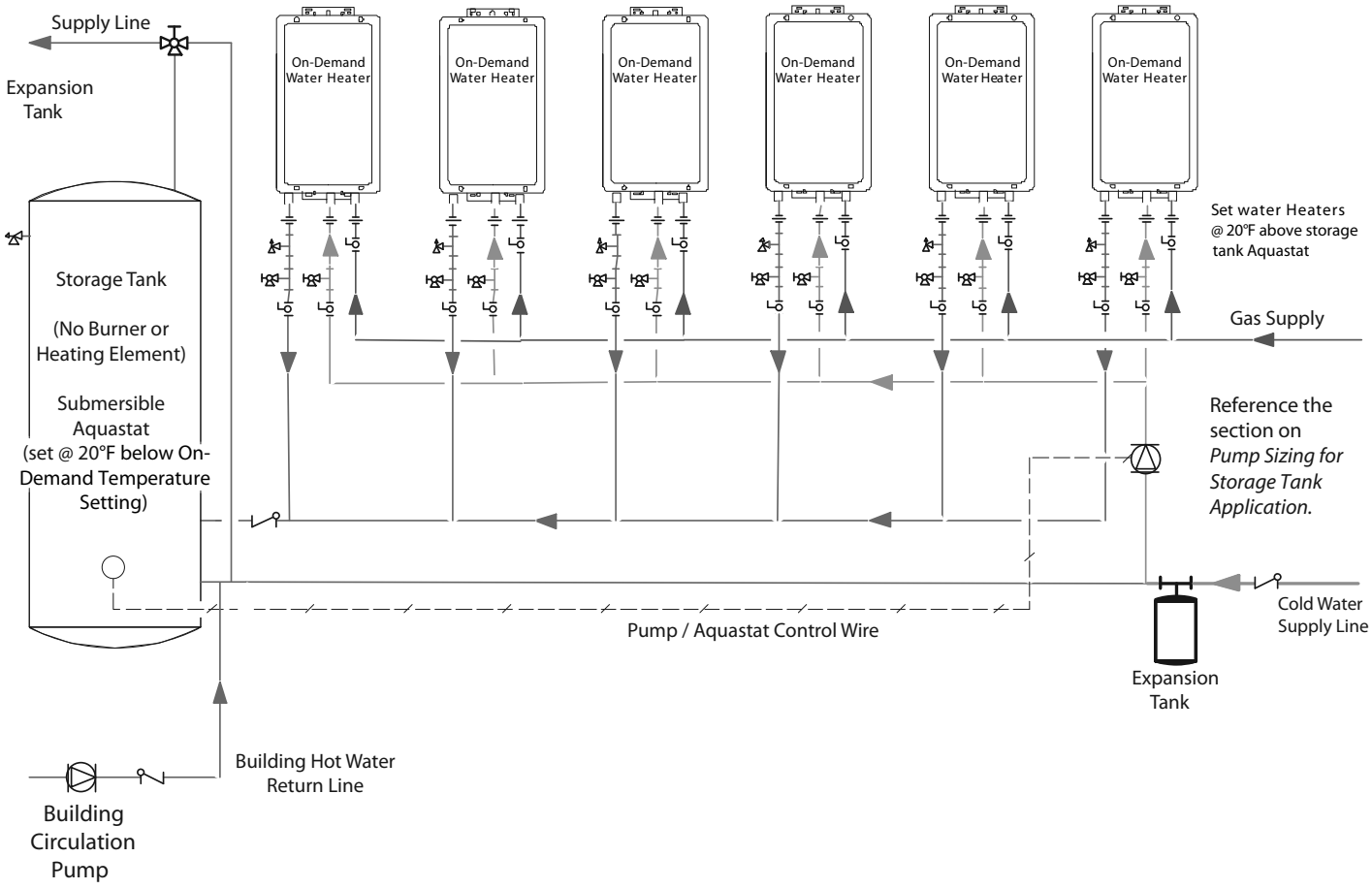
On-Demand Equipment List	QTY
On-Demand Water Heaters	6


Supply Line
Expansion Tank
On-Demand Water Heater
On-Demand Water Heater
On-Demand Water Heater
On-Demand Water Heater
On-Demand Water Heater
On-Demand Water Heater
Set water Heaters @ 20°F above storage tank Aquastat
Gas Supply
Storage Tank
(No Burner or Heating Element)
Submersible Aquastat (set @ 20°F below On-Demand Temperature Setting)
Reference the section on *Pump Sizing for Storage Tank Application.*
Cold Water Supply Line
Pump / Aquastat Control Wire
Expansion Tank
Building Hot Water Return Line
Building Circulation Pump

Domestic Hot Water - Backup Storage / Circulation
6 On-Demand Water Heaters
Preferred Piping Installation

Key

- 3/4" Ball Valve
- 3/4" Union
- Check Valve
- Pressure Relief Valve
- Pressure Regulator
- Circulating Pump
- Boiler Drain Valve
- Solenoid Valve
- Mixing Valve

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Drawing Date: September 07, 2008

Drawing Number: H-6-TC

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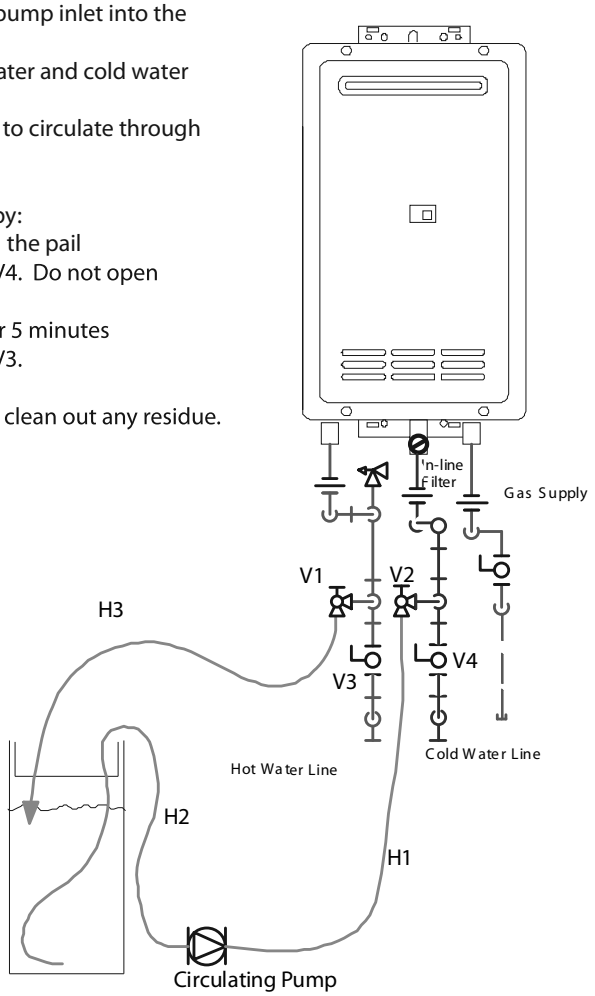
Flush Procedure

1. Disconnect electrical power to the water heater.
2. Close the shutoff valves on both the hot water and cold water lines (V3 and V4).
3. Connect pump outlet hose (H1) to the cold water line at service valve V2.
4. Connect drain hose (H3) to service valve V1.
5. Pour approximately 4 gallons of virgin, food grade, white vinegar or citric acid into pail.
6. Place the drain hose (H3) and the hose (H2) to the pump inlet into the cleaning solution.
7. Open both service valves (V1 and V2) on the hot water and cold water lines.
8. Operate the pump and allow the cleaning solution to circulate through the water heater for at least 45 minutes.
9. Turn off the pump.
10. Rinse the cleaning solution from the water heater by:
    a. remove the free end of the drain hose (H3) from the pail
    b. close service valve, V2, and open shutoff valve, V4. Do not open shutoff valve, V3.
    c. allow water to flow through the water heater for 5 minutes
    d. close service valve, V1, and open shutoff valve, V3.
11. Disconnect all hoses.
12. Remove the in-line filter at the cold water inlet and clean out any residue. Place filter back into unit.
13. Restore electrical power to the water heater.



Maintenace - Scale Flush Procedure
1 On-Demand Water Heater

Key

3/4" Ball Valve
3/4" Union
Check Valve
Pressure Relief Valve
Pressure Regulator
Circulating Pump
Boiler Drain Valve
Solenoid Valve
Mixing Valve

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